Effect of a New Nationally-Mandated Healthy Competitive Foods Policy on Middle School Students' Dietary Intake

Georgianna Mann

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Elena L. Serrano, Chair
Susan E. Duncan
Valisa E. Hedrick
Kathy W. Hosig
Vivica I. Kraak
Eileen S. Anderson-Bill

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ABSTRACT

Nearly one-third of children in the United States (U.S.) are classified as overweight or obese. Weight status in childhood and adolescence has been tied to adult obesity, which also affects more than one-third of adults in the U.S. Availability of foods and beverages can affect dietary habits, particularly in schools. Students spend most of their waking hours and consume almost half of their daily energy intake in schools. In July of 2014, competitive foods and beverages were required to meet the U.S. Department of Agriculture's *Smart Snacks in School* nutrition standards. Competitive foods and beverages are items sold outside of the National School Lunch Program and School Breakfast Program. Competitive foods include items offered à la carte, in vending machines, in school stores, and as fundraisers. The goals of this study were to: 1) examine the nutritional quality of competitive foods and beverages in vending machines and as à la carte available to students and 2) assess snack food and beverage intake by students before and after the implementation of the new standards in a sample of middle schools in rural Appalachian Virginia. Eight middle schools with higher than 50% of student eligibility for free or reduced priced lunches were included in the sample. Audits of food and beverage products sold in vending machines and à la carte were completed in the spring of 2014 and 2015. Food frequency questionnaires were completed by students in participating schools. Results showed improvements in school food offerings, though no schools were completely compliant with the new standards. The components of students' diets did not change significantly during the study period, suggesting that improved compliance may not be enough to create a dietary shift. Foods were often replaced with reformulated versions of the same products sold before the

implementation of the standards. Incentives for schools to sell more nutrient-dense options such as fruits and vegetables may be helpful to create changes in student's diets. Schools may also require additional training and assistance to fully implement nutrition standards and reach full compliance. Further research is needed to understand barriers to and possible solutions for offering healthier foods and beverages to students in middle schools.

DEDICATION

This dissertation is dedicated to those working in the school system. You have tough jobs, and make an enormous difference in the lives of students. Cafeteria managers, your devotion to serving these students meals is unparalleled. It was eye-opening to see how hard the job truly is, and why standards are not always easy to meet. Your honesty and obvious concern for your students is inspiring and I will not forget it.

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TABLE OF CONTENTS

ABSTRACT ..... **ii**
DEDICATION ..... **iv**
ACKNOWLEDGEMENTS ..... **v**
LIST OF TABLES AND FIGURES ..... **x**
LIST OF ABBREVIATIONS ..... **xi**
ATTRIBUTION ..... **xii**
Chapter 1: Effect of a New Nationally-Mandated Healthy Competitive Foods Policy on Middle School Students' Dietary Intake **1**
Introduction 1
Study Purpose 3
Study Goals 3
Study Hypotheses 4
References 5
Chapter 2: Literature Review **10**
Childhood Obesity 11
School Role in Fostering Healthy Lifestyles 29
School Food and Nutrition Policies 36
References 58
Chapter 3: The Availability of Competitive Foods and Beverages to Middle School Students in Appalachian Virginia Before Implementation of the 2014 Smart Snacks in School Standards **76**
Abstract 76
Introduction 78
Methods 79
Results 82
Discussion 86
Acknowledgments 88
References 89
Chapter 4: Middle School Compliance with National Nutrition Standards for Competitive Foods and Beverages Available to Students in Southwest Virginia **92**
Abstract 92

Background 93
Methods 94
Results 96
Discussion 102
References 109
Chapter 5: Smart Snacks in School Legislation Does Not Change Self-Reported Snack Food and Beverage Intake of Middle School Students in Rural Appalachian Region 114
Abstract 114
Introduction 116
Methods 117
Results 119
Discussion 121
Conclusions 126
Acknowledgments 126
References 127
Chapter 6: Conclusions 131
Effects on School Food Environment 131
Effects on Student Diet Quality 133
Implications for Policymakers 134
Implications for School Nutrition Professionals 136
Implications for the Food and Beverage Industry 137
Implications for Researchers 138
Final Conclusions 139
References 140
Appendices 146
Appendix A: IRB Approval Letters 146
Appendix B: Recruitment Letter to Schools 149
Appendix C: Letter to Parents 150
Appendix D: Diet Survey 151
Appendix E: Audit Instrument 154
Appendix F: Baseline Photographs 156
Appendix G: Post-Implementation Photographs 158

LIST OF TABLES AND FIGURES

Chapter 2: Literature Review

Table 1: Summary of Middle School *Smart Snacks in School* General standards 54

Table 2: Summary of Middle School *Smart Snacks in School* Nutrient standards 55

Chapter 3: The Availability of Competitive Foods and Beverages to Middle School Students in Appalachian Virginia Before Implementation of the 2014 Smart Snacks in School Standards

Table 1. Compliance of à la Carte Foods and Beverages With *Smart Snacks in School Standards*, Schools With High Rates of Students Eligible for the Free or Reduced-Price National School Lunch Program, Appalachian Virginia, 2014 81

Table 2. Schools in Compliance with *Smart Snacks in School* Standards for à la Carte Foods, by Nutrient Category Standard, Appalachian Virginia, 2014 82

Chapter 4: Middle School Compliance with National Nutrition Standards for Competitive Foods and Beverages Available to Students in Southwest Virginia

Table 1. Summary of à la Carte Foods and *Smart Snacks in School* Compliance with Smart Snacks in School in Schools with High Rates of Students' Eligibility for the Free or Reduced Price National School Lunch Program in southwest Appalachian Virginia in 2014 and 2015 91

Table 2. School Compliance with *à la Carte* Foods by Nutrient Category Standard of the *Smart Snacks in School* Standards in southwest Virginia in 2014 and 2015 93

Figure 1. Types of foods beverages offered as à la Carte and in southwest Appalachian Virginia middle schools in 2014 before Smart Snacks in School 95

Figure 2. Types of foods beverages offered as à la Carte and in southwest Appalachian Virginia middle schools in 2015 after Smart Snacks in School 96

LIST OF ABBREVIATIONS

BMI	Body Mass Index
BSQ2	Beverage and Snack Questionnaire 2
CDC	Centers for Disease Control and Prevention
CSFII	Continuing Survey of Food Intake by Individuals
ECLS-K	Early Childhood Longitudinal Study
F/R	Free or reduced price
FV	fruit and vegetable
HHFKA	Healthy, Hunger-Free Kids Act of 2010
IOM	Institute of Medicine
LNED	low-nutrient, energy-dense
NHANES	National Health and Nutrition Examination Survey
NSLP	National School Lunch Program
SBP	School Breakfast Program
SoFAS	solid fats and added sugars
SSB	sugar-sweetened beverages
USDA	United States Department of Agriculture

ATTRIBUTION

A short description of contributions made by collaborators that assisted with chapters of this dissertation is given in the following section. Three of the chapters included in this dissertation were manuscripts with coauthors.

Chapter 3: The Availability of Competitive Foods and Beverages to Middle School Students in Appalachian Virginia Before Implementation of the 2014 Smart Snacks in School Standards

Vivica Kraak (Department of Human Nutrition, Foods, and Exercise, Virginia Tech) provided edits of the manuscript. Elena Serrano (Department of Human Nutrition, Foods, and Exercise, Virginia Tech) provided study design, assisted with data collection planning, statistical analysis and edits of the manuscript.

Chapter 4: Middle School Compliance with National Nutrition Standards for Competitive Foods and Beverages Available to Students in Southwest Virginia

Vivica Kraak (Department of Human Nutrition, Foods, and Exercise, Virginia Tech) assisted with data interpretation and provided edits of the manuscript. Elena Serrano (Department of Human Nutrition, Foods, and Exercise, Virginia Tech) provided study design, assisted with data collection planning, statistical analysis, data interpretation, and edits of the manuscript.

Chapter 5: Smart Snacks in School Legislation Does Not Change Self-Reported Snack Food and Beverage Intake of Middle School Students in Rural Appalachian Region

Angang Zhang and Sumin Shen (Department of Statistics, Virginia Tech) provided statistical analysis assistance. Kathy Hosig (Department of Population Health Sciences, Virginia Tech) assisted with data interpretation and provided edits of the manuscript. Elena Serrano (Department of Human Nutrition, Foods, and Exercise, Virginia Tech) provided study design, assisted with data collection planning, statistical analysis, data interpretation, and edits of the manuscript.

Chapter 1: Effect of a New Nationally-Mandated Healthy Competitive Foods Policy on Middle School Students' Dietary Intake

Introduction

In 2012, nearly one-third of children and adolescents, ages 2-19 years, were overweight (14.9%) or obese (16.9%) in the United States (U.S.).[1] Specifically, 17.5% of children 6-11 years old and 20.5% of adolescents 12-19 years are obese based on 2014 data.[2] Obesity in childhood increases the risk for adult obesity,[3] in addition to cardiovascular diseases, type 2 diabetes, asthma, other respiratory issues, liver disease, and certain types of cancer.[4-6] Obesity can also impose psychological trauma including social isolation, adult rejection, self-blame and increased risk of depression.[7,8] Medical costs have been estimated at an additional $19,000 more for an obese child over his or her lifetime compared to a child with a healthy weight.[9]

Several dietary factors may contribute to poor diet quality and obesity among children, including the type and frequency of snacks consumed. Although snacks offer an opportunity to provide important nutrients to children's diet, frequent snacking has been associated with higher intake of total energy and excessive calories from solid fats and added sugars (SoFAS).[10,11] SoFAS is a term used in the Dietary Guidelines for Americans 2010 that replaced the previously used term, low-nutrient and energy-dense (LNED).[12] Assessments in schools and retail stores have also indicated that energy-dense, nutrient-poor snacks are available in settings where children and adolescents spend time.[13,14] These types of snack foods and beverages have been found to replace healthier foods in children's diet, such as fruits and vegetables and healthier beverages including water and non-fat milk.[15] Nearly one-third of children's' daily caloric intake is derived from snacks, as snacking behaviors between meals has become more common in the U.S., averaging three times per day.[16]

Children and adolescents from the ages of 5 to 17 years old spend the majority of their waking hours in school settings and consume 35-40% of their daily calories in schools.[17] Over 79 million children and adolescents attend public schools in the U.S. daily.[18] In 2014, approximately 35.1 million students were in prekindergarten through grade 8 with approximately 5 million students attending private schools.[19] While in schools, students are often exposed to competitive foods, defined as foods and beverages sold in competition with the School Breakfast Program (SBP) and the National School Lunch Program (NSLP) at any time during the school day, within or outside of the cafeteria.[20] Sources of competitive foods may be vending machines, school stores, fundraising efforts, and *á la carte* items, which are foods sold in the cafeteria outside of the NSBP and NSLP.[21] The most popular venues in 2014 for competitive foods are *á la carte* and vending, with 77% and 53% of middle school students attending schools offering foods in these venues, respectively.[14] Competitive foods and beverages are often high in SoFAS that may contribute to unhealthy weight gain and increase the risk of obesity and chronic diseases during adulthood.[22,23]

Appalachia is a unique, disparate region covering twelve states on the eastern U.S. nestled in the Appalachian Mountains.[24] Forty-two percent of the Appalachian region is classified as rural, and historically the economy is based on mining, forestry, agriculture and heavy industry.[25] Children living in rural regions are more likely to be obese than those in urban areas and an acceptance of being overweight is generally supported in Appalachia.[26,27] In addition to childhood overweight and obesity, Appalachia is widely affected by hunger, poverty, and severe health disparities which include adult obesity, preventable diseases, disabilities, and premature death.[25,28,29]

Study Purpose

The purpose of this study is to examine the effect of a new national policy, *Smart Snacks in School* that was implemented on July 1, 2014, on the nutritional quality of competitive foods and beverages offered in schools, as well as changes to the diets of middle school students in a rural region of southwest Virginia. These new standards are more restrictive that Virginia's state standards.[30,31] One national evaluation suggests that there may be regional and socioeconomic disparities which may influence the implementation of school foods policies.[32] Studying the effects of states implementing the *Smart Snacks in School* regulation will help to inform policy-makers about the impact of the standards and may help school-based programs to further improve the food environment and the dietary quality of students living in rural areas. This study contributes novel information on understanding how policy affects the food environment in rural Appalachian middle schools and adds substance to the theory that national policy will ultimately change foods offered in schools, detailed in chapters 3 and 4. In chapter 5 components of students' diets both before and after implementation of the standards are examined. In chapter 6 conclusions are drawn about the overall effectiveness of the national policy in this specific sample of rural Appalachian middle schools.

Study Goals

The goals aims of this study were to:

1) Evaluate changes to middle school students' snack-related food and beverage environment (including vending machines and *à la carte* items) in a high-poverty area of rural southwest Virginia.

2) Assess the contribution of school snack foods to the in school dietary intake of middle school students in a high-poverty area of rural southwest Virginia.

Study Hypotheses

Three hypotheses guided this study design, including:

1) Prior to the *Smart Snacks in School* policy, snack foods and beverages available for purchase by middle school students in a high-poverty area of rural southwest Virginia will not be fully compliant.
2) The partial or full implementation of the *Smart Snacks in School* policy will improve the nutritional value of the snack foods and beverages available for purchase by middle school students in a high-poverty area of rural southwest Virginia.
3) The implementation of the *Smart Snacks in School* standards will improve the overall dietary intake of middle school students, while at school, in a high-poverty area of rural southwest Virginia.

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new meals standards: Minimal backlash, but rural and socioeconomic disparities exist. *Child Obes* 2014;10(4)**:**7.

Chapter 2: Literature Review

Introduction

Childhood and adolescence are important times to consider lifestyle habits to create a healthy adulthood.[1,2] The World Health Organization's Commission on Ending Childhood Obesity has addressed this issue as a rising concern and has called for national governments to intervene.[3] The United States Department of Agriculture (USDA), Institute of Medicine (IOM), and American Heart Association have issued recommendations to support healthy eating and nutritious foods in schools.[4-6] The Healthy, Hunger-Free Kids Act of 2010 (HHFKA) used these as a foundation to regulate nutritional standards for foods and beverages sold in schools which include the National School Lunch (NSLP) and School Breakfast (SBP) programs.[7] Amending the HHFKA to encompass all foods and beverages sold in school, the *Smart Snacks in School* policy was developed in 2013 and are effective July 1, 2014.[8,9] These regulate competitive foods, that include items that directly compete with sales of the NSLP and SBP items in school. They may include vending machines, school stores, fundraising efforts, and *à la carte* items that are foods and beverages sold in the cafeteria outside SBP/NSLP.[10]

Dietary trends have changed over the past few decades, with increases in snacking frequency, caloric intake, and foods high in solid fats, and added sugars (SoFAS).[11,12] SoFAS is a term developed by the USDA.[5] These changes have been associated with increases in childhood obesity rates as well.[13] Other factors that may influence childhood obesity rates are sugar-sweetened beverage (SSB) consumption, socioeconomic status, and cultural and social norms associated with geographic location.[14-18] The food environment has been cited as being influential on the consumption patterns in children.[19] The food environment encompasses, but is not limited to, food available at home,[20] school food offerings,[21] and advertising.[22] School

environments are highly variable concerning food and beverage products offered outside of the NSLP and SBP as competitive food polices, if any were applied, were determined by districts, states, and/or individual schools prior to *Smart Snacks in School*.[23] The implementation of these new nutrition standards gives new opportunities to study the implementation, impact and overall effectiveness of nationally mandated policies.

The Child Nutrition and WIC Reauthorization Act of 2004 mandated a wellness policy for all schools participating in NSLP and SBP in 2006-2007. These policies could include one goal for nutrition education, physical activity and other school-based wellness promotion activities.[24] Evaluations of multi-component intervention programs that include both nutrition and physical activity have been found to be successful.[25] Though multi-component interventions are successful, state nutrition policies have been found to be more effective than district policies when attempting to reduce the availability of SoFAS in foods and beverages to students.[26]

Childhood Obesity

Childhood Obesity Rates and Measures

Body Mass Index (BMI) is a fair indicator for body fatness in children. It is a quick and inexpensive screening tool that can be used to identify children who may need further evaluation.[27] In order to classify children as being "at-risk" for obesity, BMI is the primary screening tool used. Recent studies have shown that children ages 8-15 years old often perceive their weight as normal even though about 42% of these children are actually obese, which requires a more objective measure other than self-reported weight status (healthy, overweight, and obese).[28] The use of a numerical BMI score based on self-reported weight and height may be a better option than only student perceptions of weight.[29]

Obesity rates among U.S. children and adolescents have been at an alarming rate since 2000. Obesity rates have not decreased but have stabilized since 1999-2012.[30] In a study examining secondary National Health and Nutrition Examination Survey (NHANES) data (n=26,690) which is representative of the U.S. population, it was found that 17.3% of children and adolescents ranging from ages 2 to 19 years, were obese. Prevalence of obesity was measured by class: overweight (BMI ≥ 85th percentile for age/sex), obesity (BMI ≥ 95th percentile), class 2 obesity (BMI ≥ 120% of the 95th percentile or BMI ≥ 35) and class 3 obesity (BMI ≥ 140% of the 95th percentile or BMI ≥ 40). Class 2 obesity is prevalent in 5.9% (95% CI, 4.4-7.4) of children and 2.1% (95% CI, 1.6-2.7) qualify for class 3 obesity. For all forms of obesity, there is a positive linear trend demonstrated over two-year cycles. Between 2009-2010 and 2011-2012 there were no significant increases or decreases, suggesting no significant changes in obesity prevalence in the most recent data and a possible stabilization of rates. However, there is an increase in Hispanic girls and non-Hispanic black boys, suggesting increases in specific race/ethnic populations. More recent studies using NHANES data from 2011-2014 have confirmed that obesity rates among children ages 2 to 19 years have not declined, but remained around 17.0% with higher rates of obesity, about 20.5%, 12-19 year olds.[13] Higher rates of obesity again were found in Hispanics and non-Hispanic black youth.

Studies have also shown that the medical costs associated with childhood obesity are rising. Over the course of an obese child's lifetime, it is estimated, based on six studies, that the medical cost will be $19,000 more than the normal weight child maintaining a normal weight as an adult.[31] Childhood obesity has been noted as a serious disease that reduces quality of life and extends beyond mere financial consequences, therefore a call for aggressive treatment is necessary to prevent adult obesity.[32]

There is evidence that childhood obesity is tied to adult obesity.[1,33] A longitudinal study, the Bogalusa Heart Study, reported the BMI of children 2-17 years old and followed up with the same participants approximately 17.6 years later (n=2,610) between 1973 and 1996. The follow-up ages were from 18-37 years of age. BMI and triceps skinfold thickness were the measures taken. Both the BMI and skinfold thickness were associated with adult BMI and skinfold thickness in the adults. Stronger correlations were found with higher aged children, but even among younger (2-5 years) children, moderate associations in BMI were found with adult BMI. Young children in the 95th percentile or higher for BMI were four times more likely to have skin fold thickness in the upper quartile for their age- and gender-specific group as an adult.

Cardiovascular health components were estimated using the NHANES 2005-2010 in adolescents 12 to 19 years old. The high prevalence of poor health behaviors, including low physical activity and poor diet, were found. Cardiovascular health factors included blood lipids, plasma glucose and blood pressure and less than 50% of adolescents in the study had greater than five ideal cardiovascular health components (scale 0 to 7).[34] Other cardiovascular implications related to obesity include, but are not limited to, higher blood pressure, inflammation, and oxidative stress.[32]

Expert committee recommendations for the prevention of childhood obesity address eating habits and physical activity behaviors such as aerobic and muscle strengthening activites.[35-38] The evidence reviewed shows that targeting certain behaviors may be successful to prevent of obesity. These include limiting the consumption of SSBs, encouraging consumption of fruits and vegetables (FVs) (combined equal 9 servings/day), limiting television, eating breakfast, limiting fast food intake, limiting portion sizes, and limiting the consumption of energy-dense, nutrient-poor foods and beverages. Expert committee recommendations also

include the roles of school and community involvement that have the potential to influence the success of obesity prevention measures.

Socioeconomic Status and Weight Status among Children

Obesity prevalence is high in low socioeconomic status groups (SES) and associations between obesity and poverty have been suggested.[39] A relationship between diet and income have been found, implying that lower income children consume more added sugars.[40] In a 2006 study, obesity trends among 12-17 year old adolescents were compared to the poverty level.[16] The 1971-1974, 1976-1980, 1988-1994, 1999-2004 NHANES (n=10,827), cross-sectional surveys from a nationally representative sample, were used. The outcomes for the study were dietary assessment (24-hour recall) and BMI. Breakfasts skipped and physical activity levels were also recorded. For all four surveys the percent below poverty level ranged between 16-22%. Those aged 12-14 years old with a BMI at or above the 95th percentile increased from 1971 to 2004 from 6.52% (not poor) and 7.75% (poor) to 16.78% (not poor) and 16.72% (poor). Overall, the percent of 12-14 year old adolescents at or above the 95th percentile was not statistically significant depending on poor or not poor status. However, there were significant differences between poor and not poor for the adolescents aged 15-17 years old, particularly in 2004 where not poor was 14.38% and poor was 23.27% $\geq$ 95th percentile BMI. This is correlated with a disparity in percentage of calories from SSBs in older adolescents. Further research based on NHANES data has suggested that children 6 to 11 living with food insecurity are at a higher risk of becoming obese than children the same age living in food secure households.[41]

In low income children specifically, school days may provide more nutrition than days spent outside of school.[42] Household income and FV intake among students in a New England study were very strongly associated, where school attendance was correlated with a higher FV

intake and on days outside of school, students had lower FV intake. However, in students from high income households, on the days away from school students had a higher FV intake than days in school. This study suggest that school food environments may have a more positive impact on the dietary quality of low income students.

The availability of competitive foods in schools also varies based on socioeconomic status.[43] In a 2013 report on a nationally representative sample, middle schools in low-SES areas had fewer à la carte sales (62% vs. 89%) and vending machines (44% vs. 62%) compared to middle schools in high-SES areas. Despite fewer competitive food sales, schools in low-SES areas often serve a higher proportion of unhealthy foods and beverages in comparison to schools in more affluent areas but competitive foods standards can help to mitigate these differences.[44] Data on the school food environment from the Early Childhood Longitudinal Study (ECLS-K) from 1998-2007 was used to analyze trends in competitive food and beverage availability and school SES. While the association between competitive foods standards and decreased availability of unhealthy snacks foods and beverages is strong, schools in low-SES areas may need additional incentives to provide healthy snack options rather than simply eliminating unhealthy options to comply with standards.

In addition to the effect of SES on implementation of policies, SES can also affect policy effectiveness at creating healthy habits and BMIs.[45] In a 10 year California study conducted in California elementary schools, the student BMIs were collected through the California Fitnessgram database. The BMIs of students (n=2,700,880) were compared from before standards were implemented (2001-2005) and after standards were implemented (2006-2010). These standards, Senate bill 677 and 12 (SB 677 and 12), were effective for elementary age students. SB 677 banned SSB sales and reduced fat content in milk to 2% or lower and became

effective in 2004. SB 12, effective 2007, imparted nutrition and portion standards on snack foods similar to *Smart Snacks* standards and was also expanded to middle and high schools. Researchers found that students in areas of lower SES had higher rates overweight and obesity. After the policy was implemented, BMI rates stabilized in low socioeconomic groups yet declined in higher socioeconomic areas. This trend was significantly different than the decrease in overweight and obese in more affluent areas. These results suggest that policy implementation and effectiveness of nutrition standards should be examined in many areas of SES, especially in high poverty regions.

Geographic Location, Dietary Status, and Weight Status among Children

The region of Appalachia, are known for high levels of poverty.[46] The risk of obesity has been associated with poverty.[47] A longitudinal study Using the National Institute of Child Health and Human Development Study of Early Child Care and Youth Development (1991-2007) examined the association between poverty and BMI from 3 to 15.5 years of age in U.S. cities (n=10). Overall 1,061 children participated in the study, where the height and weight was measured 4 times over the study period by researchers. The study found that children living in poverty before two years old were 1.66 times more likely to become obese by age 15.5 than children not living in poverty.

In a 2015 systematic review and meta-analysis of studies conducted in both specific states and nationally, higher prevalence of childhood obesity was found in rural areas compared to urban areas.[48] The meta-analysis results suggest that rural children are at a 26% greater chance than urban children to become obese (n=74,168 children). One study of preschool children did not find a difference in obesity prevalence, though all other nine studies included in the systematic review did highlight differences. The overall results from this study suggest that

disparities between childhood obesity prevalence in rural and urban areas become more apparent as children age. While disparities in childhood obesity prevalence were highlighted in this review, causes behind such disparities were not explored.

A study using two cycles of the NHANES from 2003-2004 and 2005-2006 compared BMIs of rural and urban children.[17] This study participants were 2 to 18 years old and the sample was nationally representative (n=7,882). Demographics, BMI, physical activity measures, socioeconomic status via federal poverty level percentage, electronic entertainment (hrs/d), and dietary intake were taken into account. Dietary intake was determined by average estimated daily intake of seven groups: fruits/vegetables, SSBs, milk products, fried foods, meat, added fats and dessert/sweets. In the sample, 33.1% of the children were classified as overweight or obese; between the 85th to 94th percentiles and at or above the 95th percentile for BMI, respectively. In this sample, significantly more rural children were obese than urban children, 21.8% and 16.9% respectively. In both urban and rural children, those in the obese category were more likely to drink SSBs. In urban children, those with a lower socioeconomic status were more likely to be obese.

Town, urban and rural schools were compared in a study examining vending machine offerings.[49] Schools in New Hampshire and Vermont were studied and included grades K-12 (n=26).The analysis unit was the number of filled slots in the vending machines which were classified as SSBs, diet soda, other diet beverages, plain water/zero-calorie seltzer water, flavored/vitamin water, 100% juice, milk and other. Researchers also recorded where the vending machines were located, advertising on the machine and hours of access to students. All schools had at least one vending machine and a total of 113 machines were recorded, an average of 4.3 machines per school and half were located in the cafeteria. SSBs were most common in

town schools and the fewest were in urban schools. The most common beverages in the machines were flavored water (34.8%), SSBs (23.6%) and plain water (21.8%). Most milk was flavored milk (92.2%) and one contained plain skim milk. Advertisements for bottled water were the most common (69.1%), followed by SSBs (27.7%) and milk (4.3%). However, this study did not account for stocking frequency and empty slots could have been sold out items. Additionally the records were not specific about flavored water which can greatly vary in nutritional content.

Specific geographic regions have also been suggested to play a major role in eating patterns and dietary habits.[50] Focus groups were used in two rural areas of Appalachian Kentucky in youth (8-17 years) to gain insight into healthy eating perceptions. Eleven focus groups were held (n=68 children), questions addressed healthy and unhealthy food, determinants of healthy or unhealthy eating, and elicited their suggestions for programs in their communities. Prominent themes that emerged from the focus groups were related to perceptions of healthy eating and nutrition knowledge, influences on food selection, and program recommendations. Youth interviewed associated healthy eating with consumption of FVs, portion control, and balancing physical activity with food intake. However, youth portrayed that poor eating choices could be negated by moderate physical activity. Influences on food choices were primarily influenced by preferences, convenience, cost and sensory stimuli. Restraints on time were a major concern for some youth, and the perception that healthy foods were more expensive was also expressed. Youth also noted that advertisements were hard to avoid and had a heavy influence on food choices. Programming ideas were centered on social influences. A notable difference in age groups was that the middle school age group (11-14 years) often stated the significant influence of taste preferences and noted that healthy foods were less appealing than other unhealthy foods. A central theme suggesting new policy implementation success is that

participants focused on food decisions being influenced by primarily environmental characteristics such as food availability, convenience, and price of foods and beverages.

Geographic locations, specifically rural locales, have been recently targeted for healthy lifestyle interventions due to high obesity rates in rural children.[51] The Creating Healthy, Active and Nurturing Growing-Up Environments study was an intervention that involved rural schools in California, Kentucky, Mississippi, and South Carolina, grades 1 through 6 (n=432 students) from 2007-2009. The intervention included healthier lunch options, health promotion messages, and parent/community outreach components. This intervention, after one year, resulted in significantly more combined vegetable and fruit consumption. The findings of these studies stress the importance of changing the food environment to facilitate healthy dietary behaviors.

Dietary Trends

Calories. Overall, the number of calories available for consumption in the United States has increased from 3300 calories to 3800 calories per capita (15%) over a 24 year span, from 1970 to 1994.[52] Dietary intake trends and obesity prevalence have undesirably changed since 1989.[53] In their study of 2-6 year olds, Ford and colleagues analyzed several nationally representative surveys using a single 24-hour dietary recall (n=10,647). Surveys included were the Continuing Survey of Food Intake by Individuals (CSFII) 1989-1991 and 1994-1998, the What We Eat In America survey, and the NHANES 2003-2004, 2005-2006, and 2007-2008. The study found that over this 24 year time span, the increases in snack foods were greatest for foods high in SoFAS: savory snacks, pizza, and sweet snacks/candy. Total dietary calorie consumption increased by 109 overall calories per day.

In order to target foods for weight control, a survey study using the Centers for Disease Control and Prevention (CDC) Behavioral Risk Factor Surveillance Study which asked about

consumption of targeted snack foods which include salty snacks, cookies, candy and SSBs.[54] This study, conducted among adults (average of 39.4 years, n=1,826), showed that the four targeted snack foods were consumed more (calories) in obese individuals. Consumption of these SoFAS was the most notable predictor of BMI, suggesting these foods may be appropriate targets when considering weight control. However, the increase in snacking behavior has not been found to be directly related to the weight status of children and adolescents.[55]

A cross-sectional study of 4 to 16 year old children which examined activity patterns, fat intake and childhood obesity revealed a correlation between calories consumed, fat consumed and obesity.[56] Both obese and healthy weight individuals were included in the study (n=181). A diet analysis was performed using a 24-hour recall and food frequency questionnaire. The results showed that obese subjects consumed significantly more calories, fat, saturated fat, and sugar which equated to around 500 calories/d more than the healthy subjects. For the healthy weight individuals the fat consumption ranged from 30-155 grams/day (g/d) compared to the obese individuals where fat content ranged from 34-469 g/d. Averages of sugar consumption were 134±46 g/d and 167±60 g/d respectively. Both BMI and percent body fat was found to be strongly tied to total energy consumed.

Solid Fats, Added Sugars. Analysis of NHANES data from 2005-2008 by the CDC reveals about 16% of children and adolescent caloric intake is derived from added sugars, most of the added sugars come from foods rather than beverages.[57] About 40% of added sugars are derived from beverages. Boys 6-11 years old consume 345 calories/day from added sugars and girls that age consume 293 calories/day from added sugars. Older aged boys and girls consumed 442 calories/day and 314 calories/day (12-19 years). Children were found to consume most of

their added sugars at home. No significant differences were found between the consumption of added sugars and the poverty income ratio.

SoFAS are prevalent in American diets today, demonstrated by an analysis of the NHANES 2001-2002 using a 24-hour recall in people over 2 years of age (n=8,650).[11] Discretionary calories are defined by the USDA as calories remaining in a person's diet after accounting for the number of calories needed to meet nutrient needs from healthier food options (low-fat or no sugar added). These discretionary calories are often fulfilled through the consumption of SoFAS. The maximum allotted discretionary calories are recommended to be no more than 20 percent. However, this study found that children aged 9-13 consumed enough SoFAS to account for 37 percent of their overall caloric intake. All age and gender groups exceeded the maximum allotment of discretionary calories. Contributing to this increase in energy intake is soft drink consumption, totaling 16% of total energy intake based on individual 24-hour recalls with nearly 20% of energy intake in adolescents coming from added sugars (n=15,010).[58]

Primary sources of energy, fats and added sugars in children and adolescents have been studied using the NHANES.[12] Sources of total energy were calculated from the 2005-2006 survey and sources of SoFAS were calculated from the 2003-2004 survey. Each were assessed by means of 24-hour recalls, with participants under 6-11 years old having a proxy-assisted interviews. Results analyzed data from children 2-18 years old. The top energy source, providing 138 calories per day, for this age group were grain desserts including cake, cookies, pastries, pies, crisps/cobblers and granola bars. Other significant contributors to calories/d consumed were pizza, soda, yeast breads and chicken dishes. Each contributed 136 calories, 118 calories, 114 calories, and 113 calories per day, respectively. The average daily intake of calories from solid

fats was 433 calories/d, primarily from pizza, grain desserts, whole milk, regular cheese and meats. Older children (14-18 years old) had more solid fat from fried potatoes. Added sugars comprised 365 calories/d of children's diets. The major sources of added sugars were soda, fruit drinks, grain deserts, dairy desserts and candy. Cold cereals contributed a significant amount of added sugars in 2-8 year old children. These SoFAS contributed to about 40% of total calories consumed, or about 798 calories/d and are considered to be empty calories. SSBs were found to be the primary contributor, accounting for 22% of empty calories consumed by children. In middle school age children (9-13 years old), the primary sources of energy were grain desserts, pizza, children, yeast breads, and soda.

Sugar-Sweetened Beverages. SSB consumption and childhood obesity are strongly tied.[6,11,15,53,56,59-61] SSB consumption is also tied to increased cardiovascular risk in both normal weight and overweight or obese individuals.[14,15]

Further studies have compared trends in SSB consumption over time. In an examination of day one 24-hour recalls from the NHANES 2005-2010, the most common beverages in youth ages 2-18 years old were found to be water, milk and soda.[62] Beverages in the study were categorized: water, milk, soda, 100% juice, fruit drinks, coffee/tea, and low-calorie/diet drinks. Obese children consumed more soda and less milk than normal weight children. Fewer normal weight children consumed low-calorie/diet drinks in comparison to obese children. Age categories were further broken down into 2-5 year olds, 6-11 year olds and 12-18 year olds. Six-11 year olds consumed the most calories from added sugar from milk. Among consumers of soda in the 6-11 year old age group, obese children consumed 170 added calories from sugar per day.

One study reported per capita trends in consumption of beverages in 6-11 year old children (n=3,583).[63] The study compared data from the CSFII 1989-1991, the NHANES 2005-

2006 and 2007-2008. The 1989-1991 survey included a 3d 24-hour recall by a single interviewer, with caretakers reporting children's beverages consumption. NHANES included one 24-hour dietary recall from two days (nonconsecutive) via interview both in person and via telephone. The largest increase in per capita consumption of SBBs was found for fruit and soft drinks, high fat high sugar milk, and sports drinks. Another finding from this study is that beverage trends show portion sizes are increasing. For example in 1989-1991, 304 mL/d of SSBs were consumed and in 2007-2008 468 mL/d were consumed per capita, a significant difference. Additionally, 80% were consumers of SSBs compared to 91% in 1989-1991 to 2007-2008. This increase in consumption of SSBs also comes with a rise in caloric intake per capita, from 130±11 calories/d to 209±8 calories/d from 1989-1991 to 2007-2008, a significant change.

The relationship between sports drinks and BMI in youth ages 9-16 was analyzed in a 2004 study using a cohort design.[64] Data from the Growing Up Today Study II 2004, 2006, 2008, 2011 were used (n=7,559 youth). The Youth/Adolescent Questionnaire, a food frequency questionnaire, assessed intake of SSBs in the students and the BMIs were calculated using self-reported weight and height. The beverages of interest were regular soda, diet soda and sports drinks. The change in consumption of these beverages over time were examined. Television time was also included as well as physical activity. At baseline, BMI and diet soda had a positive association (greater than one beverage per day), but regular and sports drinks intake were unrelated to BMI. However, in the 2008 questionnaire, dieting for weight control was also positively associated with diet beverage intake. The study results additionally found that the consumption of sports drinks were predictive of weight gain. The researchers reporting these results suggest that focuses on policy should target sports beverages.

Another study incorporated data from 1999-2010 to track trends in SSB consumption in both youth (2-19 years old) and adults (≥ 20 years old) by using data from six of the NHANES from 1999-2000 and 2009-2010.[59] SSB consumption was analyzed by means of a 24-hour dietary recall using a computer-assisted dietary interview. In surveys after 2003, two 24-hour recalls were conducted but before 2003 only one was conducted. Parents reported dietary intake for children 5 years old and under, and assisted with children 6-11 years old. SSBs were defined as beverages sweetened with sugars (ex: sucrose, glucose, high-fructose corn syrup, etc.) and include soda, fruit drinks (not 100% juice), sports drinks, energy drinks, sweetened teas, sweetened coffee and other drinks with added sugars. One-third of all panelists' interviews reported that they consumed one or more SSB during their 24-hour recall. In 2009-2010 the youth participants consumed about 155±7 calories/d from SSBs, though this is a decline since 1999. Over the 12 year time period, sports and energy drink consumption increased, but there was an overall net decrease in calories from beverages. Currently SSBs comprise 8.0%±0.4% of daily energy consumption in youth.

Further research on beverage consumption trends show an overall decline in energy intake from beverages.[65] The study combined results from 1977–1978 Nationwide Food Consumption Survey, the 1989–1991 Continuing Survey of Food Intake by Individuals, the 1994–1996 Continuing Survey of Food Intake by Individuals, NHANES 2003–2004, and NHANES 2005–2006. While overall energy consumption from beverages has decreased, soda consumption has risen since 1977-1978 from 87.4 calories per capita to 153.7 calories per capita in 2005-2006 in children (2-18 years old). Water consumption, in ounces per capita, have decreased from 624 ounces to 552 ounces. In 2005-2006 children ages 7-12 were consuming

approximately 348 calories per capita from beverages, with 140 calories from soda and 121 calories from whole fat milk.

A study focusing on California youth found that children have decreased the number of SSBs consumed while adolescents have increased SSB consumption.[66] This survey used data from the California Health Interview Survey from 2005-2012 (n=40,000 households per cycle). From 2005-2007 to 2011-2012 the percent of children drinking one or more SSBs per day declined for children ages 2-5 and 6-11. However, there was a significant increase from 60% to 65% of adolescents 12-17 drinking one or more SSB per day. The increase in SSB consumption was from sports, energy or sweetened fruit drinks. There was a decline in soda consumption.

A two-year study examined the consumption patterns of SSBs in middle school age children and their correlating BMIs.[67] The subjects were 11.7±0.8 years old at the start of the study (n=548). BMI, skinfold thickness, dietary intake, physical activity, and television viewing habits were recorded at the beginning and end of the study. SSB consumption was ascertained by means of the Youth Food-Frequency Questionnaire. Overall, during the course of the study SSB consumption increased: 57% of participants showed an increased intake, with some showing more than an additional serving of SSBs per day. SSB consumption increased significantly from 1.22±1.10 servings/d to 1.44±1.09 servings/d. There were no significant changes in BMI observed, yet there was a slight increase in BMI with 9.3% more children classified as obese after the second data collection.

Suggestions made are to reduce SSB consumption during childhood as a strategy to reduce risk cardiovascular incidences through the lifespan.[30] Decreasing SSB consumption has been shown to have an effect on body weight in adolescents in a randomized, controlled study environment.[60] For this particular study, adolescents who regularly drink SSBs (at least 12

ounces/d) ranging from 13 to 18 years old were enrolled in a program delivering non-caloric beverages to replace the normal SSB consumption (n=103). Other SSB consuming adolescents in the study were asked to continue regular consumption. Significant changes in BMI for the enrolled participants were evident after this 25 week intervention where there was a net difference in the two groups of 0.75±0.34 kg/m^2, the control group maintaining the higher BMI. This study implies that SSB consumption may be an appropriate target for weight control.

Whole Grains. Whole grain intake in children 2-17 years old in the United States does not meet the recommendations as of 2013.[68] Using the CSFII 1994-1996, a nationally representative sample of the United States whole grain intake was obtained via a one-day recall (n=4,802).[69] Socioeconomic and demographic data was included. Among the top three sources of grain foods for children 2-18 years old are yeast breads, ready-to-cereals, and pizza. A mere 16.4% of adolescents consume 2 or more servings of whole grains out of the 3 recommended. Those that are below the Federal poverty threshold were more likely to consume no more than one serving of whole grains per day. It seems that total grain intake is sufficient but whole grain intake is lacking.

Fruits and Vegetables. Many children living in the United States ages 2-17 do not meet the recommendations for vegetable consumption.[68] NHANES data was examined from 2003-2004, 2005-2006, 2007-2008 and 2009-2010 for fruit and vegetable intake.[70] Measures of fruit and vegetable intake was taken in 24-hour recalls in cup equivalent per 1,000 calories. Children ages 2-18 years old were included in the study. Significant increases in fruit consumption were noted (3% increase from 2003-2004 to 2009-2010) with increases in whole fruit consumption and decreases in fruit juice consumption. Vegetable consumption remained constant, with about one-third of vegetable servings from potatoes alone.

Sodium. A recent analysis of the NHANES 2009-2010 and What We Eat in America found that children ages 6-18 years consume far too much sodium (n=2,266).[71] Approximately 3,300 mg of sodium per day is being consumed which is far beyond the recommendation of 1,500 mg per day. Specifically, children ages 11-13 are consuming approximately 1,983 calories per day along with 3,194 mg of sodium per day. The most sodium in diets, slightly less than half (43%), is derived from pizza, breads, sandwich meats, popular fast food items (burgers, chicken nuggets), chips, cheese, pasta dishes, soups and Mexican mixed dishes. Additionally, most of the sodium in a diet is in processed foods (65%).

Concerns over the sodium regulations for NSLP have been raised, by the School Nutrition Association.[72] The School Nutrition Association notes that the sodium targets may present major issues with acceptability from students. However, the American Heart Association supports the new NSLP meal standards as well as the *Smart Snacks* sodium limits, citing numerous studies with evidence that high sodium levels negatively impact health in children.[73] The American Heart Association also attempts to correct negative commentary that companies are unable or unwilling to reformulate products to meet the standards.

Nutrition Recommendations

The USDA has provided guidance to help schools improve the food environment for students.[74] Some suggestions include placing limits on vending machine contracts by restricting unhealthy options and offering a variety of healthy options for food sales such as fresh fruits and low-fat yogurt. Documented success stories include schools that removed unhealthy options like SSBs, chips, candy, and fried snacks. These schools in turn added other foods like fresh fruit, air-popped popcorn and salad options.[74] Marketing healthful choices is also encouraged by giving

these items priority placement in high-traffic areas and keeping prices reasonable or perhaps increasing prices of less-healthful foods. Additionally, limiting access to snacks is suggested to reduce unhealthy food consumption.[75] Examples of restricting access are turning off machines at certain times or changing location where foods and beverages may be sold. Fundraising activities are encouraged to include non-food items, fresh fruit, nuts, or popcorn.[74]

The American Heart Association encourages diets that are primarily fruits, vegetables, whole grains, low-fat dairy items, beans, fish and lean meats.[4] These guidelines are consistent with the USDA's Dietary Guidelines for Americans.[5] There has been a significant increase in the past twenty years in savory and sweet snack consumption.[53] Fruit consumption has increased with more whole fruits consumed but vegetable consumption is still comprised of one-third white potato products (including fried potatoes and potato chips).[70] SSB consumption appears to have declined over the past decade but remains high in adolescents.[59] The American Heart Association notes that adolescence is a vulnerable developmental stage yet in this crucial time, children are getting the nourishment they need from recommended foods which results in excess fat, higher risk of diabetes and heart disease.[4] Recommendations for schools include banning food advertising on campus, developing policies to promote student health, lobby for nutritious foods being served, and establishing legislation to promote student health.[74] Legislation recommendations by the American Heart Association are BMI measures to report to parents by school officials, restrictions of foods and beverages on school campus, school wellness policies such as physical activity goals and food advertising regulations.[4]

Similar to nutrition recommendations, short-term interventions have had limited long-term effects at combatting obesity. Supporting evidence-based policy recommendations may be the best approach to reversing obesity epidemic.[76]

School Role in Fostering Healthy Lifestyles

The Child Nutrition and WIC Reauthorization Act 2004

In 2004, The Child Nutrition and WIC Reauthorization Act of 2004 mandated that local education agencies involved in school meal programs to implement a wellness policy in 2006-2007. Requirements established for the local wellness policy as outlined by the Child Nutrition and WIC Reauthorization Act of 2004 include the establishment of one goal for nutrition education, physical activity and other school-based wellness promotion activities. Additionally, it includes the nutrition guidelines of all foods on school campus, assurance that USDA regulations are met on reimbursable meals, a way to measure local wellness policy implementation, and designation of an individual to ensure that the school meets the local wellness policy. With the implementation of the HHFKA, schools must amend their school wellness policies to meet the new requirements which adds public input, transparency, implementation and review to enforce local wellness policies.[77]

A multistage examination study focused on state school nutrition legislation, qualitative interviews with foodservice directors, and a mail/email survey for foodservice directors.[24] The state assessment was done in all 50 states and analyzed regulations in 2004 and 2006 in the following categories: policies on food content (fat/calories/sugar), portion restrictions, time and place sales, and wellness policy training. Foodservice directors were selected from both states with strong policies and weak policies (n=21). Lastly, foodservice directors were surveyed from larger schools (2,500 students or more) in a stratified random sample (n=847). In 2004, 30 states had no wellness policies as described and only 3 states had 5 or more of the policies in place. In 2006, 22 states had 5 or more policies. Foodservice directors noted that before the legislation

only 37.4% of the policies were implemented but after legislation 72.4% of the components were in place. There was more nutrition addressed in the curriculum, an increase of nearly 30%. Results indicate the wellness polices in place were increased after the federal mandate.

Responses to the Child Nutrition and WIC Reauthorization Act of 2004 were also measured in Virginia.[78] Each school division that participates in the NSLP was required to implement a local wellness policy as outline by the 2004 act by the end of fall 2006. This study focused on surveys administered to School Health Advisory Board coordinators in Virginia with a 69.7% response rate (n=92). The questionnaire inquired about the timeline of implementation, the person in charge of the local wellness policy implementation, methods of assessment for development of the policy, focus areas for nutrition education, physical activity and nutrition standards, school based activities for wellness promotion and resources that may be needed. As of March 2006, a mere 2.2% of respondents reported that a policy had been adopted. However, 96.7% of respondents noted that work had begun on the local wellness policy for their respective school division. In respect to the nutrition standard creation, the focus of the standards were primarily on competitive food regulation. 89.1% of the school divisions responding noted that they had at least one evaluation goal which entailed BMIs, surveys, local wellness policy evaluation and documenting policies made.

School-Based Intervention Programs

Incidence of overweight in children enrolled in grades 4 through 6 has been shown to be affected by a multi-component intervention program.[25] This program was part of the School Nutrition Policy Initiative and compared 5 control schools with 5 schools that underwent the intervention program in the Philadelphia school district (n=844 students). This program included school self-assessment, nutrition education, nutrition policy implementation, social marketing

promoting healthy foods, and parental outreach/involvement. Schools included in the study had 50% of students eligible for F/R lunches. Nutrition policies included limits on the types of beverages offered: 100% juice (<6oz), water, and low-fat milk (<8oz). Snack standards permitted less than or equal to 7 g total fat, 2 g saturated fat, 360 mg of sodium and 15 g of sugar per serving. Progress made by students were tracked in schools over two years with physical activity assessments, BMI and diet assessments. Dietary intake of students was assessed by the Youth/Adolescent Questionnaire, a 152-component food frequency questionnaire. Students were assessed at baseline, year 1 and year 2. Students that become overweight were fewer in the intervention schools (7.5%) than in the control schools (14.9%) after the two year period. There were no significant differences on self-reported diets of students. However, the intervention school reported significantly fewer hours of television hours per weekday.

Effects of School Food Offerings on Dietary Patterns

As of 2013, competitive foods are still widely available in middle schools in a nationally representative sample through the Bridging the Gap study.[43] Between 2007 and 2013 the availability of soft drinks, high-fat milks and french fries decreased significantly in both middle and high schools. Heathier food items such as salad bars and whole grains had not increased. Middle schools had fewer vending machines than in 2007, with vending machines in 53% of middle schools. The number of schools offering foods and beverages à la carte remained the same, about 77% of middle schools. Stores and snack bars also did not change, with 49% of middle schools offering foods and beverages in this venue. All beverages available for middle school students declined since 2007, likely due to fewer vending machines. Water, 100% juice and nonfat/1% milk were widely available (89% of schools) but has declined since 2007. Availability of SSBs also declined, from 78% to 64%. Middle schools offering free drinking

water was high, 93% during lunchtime. Availability of FVs did not change significantly in competitive venues.

A focus on competitive food consumption comparing NSLP participants and nonparticipants in a nationally representative sample noted that NSLP participants consumed fewer SSBs and energy-dense foods at school in grades 1-12.[79] This study used a cross-sectional design based on the SNDA-III from 2004-2005 which used 24-hour recall data (n=2,314 students). In particular, 29±2.6 percent of NSLP participants compared to 38±2.4 nonparticipants consumed SSBs at secondary (middle) school, totaling 45 additional calories from SSBs for participants and 61 calories for nonparticipants. For those that consumed SSBs in school, the total energy intake was 229 calories higher than students who did not consume SSBs or who consumed SSBs outside of school. Participants in the NSLP also consumed greater levels of protein, vitamin A, vitamin B-12, riboflavin, calcium, phosphorus and potassium, largely due to increased milk consumption in NSLP participants.

Estimates of impacts on NSLP participation after a proposed competitive food change have also been performed. [80]An analysis of NSLP participation in Connecticut schools, before and after the implementation of the Healthy Food Certification program in 2006, was conducted. This certification offered financial incentives to schools (elementary, middle, high) that opted to comply with food nutrition standards, similar to *Smart Snacks in School*. Two observations were taken, 2004-2005 and 2009-2010 (n=904 schools). Analysis and estimates were generated from a generalized linear mixed model for NSLP meal eligibility category and number of potential school lunches sold per year. Based on the results, it seems that with participation in the Healthy Food Certification program, more middle school free meal participation occurred as well as paid NSLP participation. Overall the Healthy Food Certification program participation was associated

with an increase in NSLP profits due to significant increases in student participation. The largest increase in participation was seen in high schools. In middle schools, the estimated increase in middle school NSLP profits was $12,000/school year. Consistent with this analysis, it would seem that a decrease in the availability of competitive foods containing SoFAS would result in a maintenance or increase in food service finances.

The School Nutrition Dietary Assessment III (SNDA-III) data were used in a 2012 Economic Research Service study to examine healthy food offerings on choices made by children.[21] This study compared how compliance with the new 2012 USDA NSLP standards affected student eating habits, particularly FVs. In this study 242 schools were examined (n=1,442). Significant findings were noted where students ate 0.03 cups more FVs in schools that met NSLP standards in comparison to schools that did not meet NSLP standards with 0.01 cups of FV per student consumed. This small, yet significant, increase in FV consumption can be attributed to some students refraining from FVs completely. Those schools that followed the new standards had 81% of students consuming one kind of vegetable or more compared to the noncompliant schools where 70% of students ate one or more vegetable variety. These findings suggest that the newly implemented policies will have a beneficial effect on student consumption of FVs.

Significant associations between FV availability and consumption in students have been found in many studies represented in a study assessing 5 years of nationally representative data.[81] Self-reported FV consumption was used from middle and high school students annually from 2008 to 2012. Middle school students were in 8th grade (n=10,254). A total of 18,898 high school students (10th and 12th grade) completed the survey. Student data were from the Monitoring the Future study and data on school food environments were from the Youth, Education, and Society

study. Fruit and green vegetable consumption frequency were recorded separately. Food environment was assessed based on availability of 5 types of items (candy/regular-fat snacks, low-fat snacks, FV, premade salads, and salad bar) in vending, school stores, *à la carte*, and school lunch meals. Availability of foods was ranked based on form, location and time the food may be consumed/is accessible to students. Fruit was consumed nearly every day or every day by 59% of middle school students, and 36% of middle school students reported consuming fruit daily. Green vegetables were consumed by 46% of middle school students nearly every day or every day and fewer ate green vegetables daily (26%). Vending was available in 73% of middle schools, school stores in 42%, and *à la carte* in 77%. FV were available in 99% of schools, and most of the FV availability was due to school meals, 66% in middle school. Salad bar access was significantly associated with higher consumption of green vegetables in middle school students. More access to candy and regular fat snacks were associated with lower fruit consumption in middle school students.

An assessment studying middle school eating environments identified foods available to middle school children in 20 selected schools during lunchtime in South Carolina schools.[82] Food and beverage items were recorded including competitive food items available during mealtimes. A total of 363 competitive food and beverage items were available. No milk, entrees, FV, or yogurt were sold outside of the school cafeteria in any of the schools. Snacks available included sweet snacks, and salty snacks (including chips) and totaled 210 different items. Ice cream was sold in 6 schools in vending machines or in freezers. Milk was available as part of the NSLP meals, and non-milk beverages totaled 122 items. Carbonated beverages accounted for 43 of the beverages offered, with 8 diet and 5 decaffeinated. Three types of water were offered to students. Of the 122 non-milk beverages, 73 were non-soda SSBs.

An association between student BMI and lunch regulations has also been found in a study examining state laws on school nutrition standards and student weight status.[83] In this study, states were classified based on if their laws for middle school lunch nutritional standards were more stringent than USDA standards during the time of the study (2006-2007). Examples of standards beyond USDA recommendations were requiring more FV at lunch, making foods whole grains, reducing *trans* fat items or having only non or low-fat milk available instead of whole milk or 2% milk. Student BMI, dietary habits, NSLP participation, and free or reduced price (F/R) eligibility data were obtained from the ECLS-K for eighth grade (n=4,870). Higher BMIs and high poverty rates were observed in states that had regulations beyond the USDA standards. This could be attributed to the obesity problems and why the increased standards were developed. In states that did not exceed USDA standards there were twice as many obese students who were on F/R lunches than those not on F/R lunches. BMI percentiles were also lower in F/R students in states that exceeded USDA standards, suggesting that stronger policies can help encourage healthier weights in students.

A longitudinal study based on the ECLS-K 1998-1999 (n=19,450 children) evaluated children from 1998 to 2007 through their 8th grade year.[84] Measures included BMIs of students, and school competitive food sales. Competitive food sales questions were nonspecific, including questions such as "can students purchase food or beverages from one or more vending machines at the school, a school store, canteen or snack bar?" Additionally, the study did not include data on location of competitive foods, hours of access or other rules that may be in place. Results revealed that students in schools that sold competitive foods in 8th grade had slightly higher BMIs, but these results were not statistically significant.

Environmental influences, including home environment, have been shown to have strong effects on eating habits of children and examination of parent-child dyads suggested a relationship between the home environment and habits developed by children.[20] A study using the Beverage Intake Questionnaire was done on parents and children aged 9-17 years old (n=95) to ascertain common beverage intake habits. In the study participants, the mean BMI of both parents and children were higher than the national average as well as their average daily caloric intake from beverages: adults consumed 451±236 calories/d and children consumed 457±237 calories/d from SSBs. In 2010, according to the National Cancer Institute, adults consumed 394 calories/d and children consumed 400 calories/d. Results showed a significant correlation in overall caloric intake of all beverages, SSB consumption, 100% juice, juice drinks, sweet tea, fat-free milk, low-fat milk, and whole milk. Results from this study showed an association between parent and child beverage consumption and supports the theory that environment influences dietary intake.

School Food and Nutrition Policies

School-Level Policies

Competitive food polices, prior to *Smart Snacks in School*, were highly irregular and determined by districts, states, and individual schools.[23] To account for general policies currently in effect for the U.S., districts with the highest student enrollment in each state and Washington DC were interviewed about school district nutrition policies on competitive foods (n=51).[85] Questions in the interview included demographic characteristics, district nutrition policies on competitive foods and current competitive food environments in schools. For most districts the interviewee was the director of Food/Nutrition Services or district dietician/nutritionist. Policies

in effect for competitive foods were compared based on component restrictions (sugar, fat, and/or sodium), size of food or beverages, venues where foods were sold, time of day when policy applies, differences in policies based on grade level, enforcement of policies in schools, and other IOM wellness recommendations. IOM recommends policies incorporating nutrition education, food advertising/marketing to students, BMI reports or physical activity guidelines.[37] At the time, these 51 districts selected accounted for 11% of students in the U.S. and 6% of schools. Competitive food policy adoption beyond state or federal requirements was found in 39% of the districts (19 districts). These adopted policies varied widely in type of policy: about half had standards differing by grade levels, and 63% (12 districts) of the 39% of districts with policies banned soda sales in all schools regardless of grade level. Soda sales were allowed in 61% of middle schools and 75% of high schools. Nearly one third (29%) of districts had exclusive contracts with a beverage company. Most often food content (sugar, fat, sodium) was restricted instead of portion size. None of the interviewed districts limited after-school fundraising or concession sales in their policy development. None of the school district policies outlined in this study met the IOM recommendations for obesity prevention in schools.

Further studies on Pennsylvania policies assessed local wellness policies and compare them to the local wellness policy mandates.[86] Additionally the study sought to provide insight on how local wellness policies were developed and implemented. A local wellness policy template was made available to local education agencies to help with local wellness policy development prior to the study. Voluntary state nutrition standards for competitive foods were developed by the Pennsylvania Department of Education and a Local Wellness Policy Checklist was also developed and completed by public school districts in Pennsylvania that sponsor school meals programs (n=499). In response to the local wellness policy mandate, 100% of the respondents

have implemented local wellness policies. Most respondents, 86.6%, acknowledged the use of a school assessment before developing local wellness policies. Most of the school distracts met these requirements, but 85.6% had established a plan for measuring local wellness policy implementation. However, the majority were successful in establishing a local wellness policy fully.

Recommended school policies in Minnesota schools demonstrated improvements in SSB consumption and FV consumption.[87] A cohort of 37 schools were examined on 8 recommended school obesity policies between 2002 and 2006. The eight recommended policies included a PE requirement, intramural sports available, FV availability, 100% juice availability, salty snack restriction, chocolate candy restriction, other candy restriction and restriction of soda/other sports drinking in competitive food venues. Of the 37 schools, 33% made no changes, 25% implemented 1-3 policies, and 42% implemented 1-6 more recommended policies. With each additional policy adapted by schools there were significant decreases in SSB consumption and increases in FV consumption. The study concludes that school policies can help foster a healthier environment compared to schools that do not adopt such policies.

In some schools, policy development is done by wellness councils which are a group of individuals which form solutions for the school environment; individuals may be from the school or the community. One study looked at the relationship between having a wellness council and the corresponding availability of low-nutrient, energy-dense (LNED) foods which are those that are greater than 3g of fat and 200 calories/serving, SSBs, or reduced-fat/whole milk (both flavored or non-flavored).[88] The study involved polling Minnesota school principals if their school and district had a wellness council. Middle (n=35) and high (n=54) schools were polled. In addition to the polling, trained researchers collected data concerned calories and g of fat per

serving of competitive foods in vending machines. For this study, all foods deemed LNED were categorized: chocolate, other candy, crackers, cakes, pastries, other high fat baked foods, salty snacks, reduced-fat/whole milk, soda, non-100% fruit juice drinks, and sports drinks. From these LNED food categories a food score for each school was calculated, higher scores correlating to more LNED availability. The schools with district and school councils or district-only councils had fewer LNED foods available than schools lacking the councils. The most common LNED foods sold were SSBs. The mean food score for schools without any sort of wellness council was significantly higher than schools/schools in districts with wellness councils.

A University of Michigan study surveyed U.S. school principals in middle and high schools as part of the Youth, Education and Society study.[89] The goal was to assess competitive food availability, focusing primarily on SSBs (both soda and non-soda). Data included questionnaires that inquired about the beverage company contracts the school had, where decision responsibility lies in beverages available, and school wellness policies or nutrition guidelines in place. Other qualities assessed were general school characteristics, nutrition programs, food/beverage supplier contacts and school wellness policies. School size, percent of students eligible for F/R lunches, student demographics and year were included. The study were included 757 middle and 762 high schools. Data was collected between 2007 and 2009. Competitive beverages were available for 96.2% of middle schools students and 99.2% of students. Most SSBs available in both middle and high schools were non-soda options such as sports drinks and fruit drinks that are not 100% juice. Additionally, having a bottling contract was associate with higher middle school soda access and higher high school access to SSBs. After implementation policies, regular soda availability dropped from 27.9% of students having access to 15.1% of middle school students; in high school it dropped from 54.1% to 33.9%.

Declines in overall SSB availability were not significant for middle or high school, though middle school students experienced a larger decline in availability compared to high schools students. Applications of this study data is limited, as only principals were questioned.

After the interim final rule of *Smart Snacks in School* was passed, a study focused on the state laws regarding food policies in schools for the school year 2012-2013.[90] All 50 states and the District of Columbia were included in the analysis. The comparison was done between school policies currently in effect and the proposed 18 new provisions to become effective July 1, 2014. It was found that 16 states had laws meeting at least one of the *Smart Snacks in School* statutes. Ten more states had laws that partially met one or more of the rules which may include policies in some school levels but not others. It was found that states were more likely to meet beverage standards rather than snack food standards. Secondary schools had fewer policies in place than elementary schools and with the new standards will probably see the greatest changes. Policies are also weaker for the secondary, rather than elementary, schools. It is suggested that certain geographic areas will struggle more than others with the coming implementation of standards.

Another study focusing on state policies regarding implementation of *Smart Snacks in School* assessed compliance provisions in place to enforce the upcoming changes in school environment.[91] The existence of state laws that incentivized compliance with state competitive food policies, required competitive food contracts in line with state nutrition standards and monetary penalties for failing to meet state laws were examined. Five states had incentives set in place ranging from grants to awards to schools. Contract compliance provisions were found in 11 states; 10 pertain to vending machines, 8 to school stores, 7 to *à la carte*, and 4 for fundraisers.

Penalties for lack of compliance are enacted in 7 states and enforced by the Department of Education, food service directors, or the Department of Agriculture.

From 1997-1998, the number of "pouring rights" contracts in school for soft drink companies doubled.[92] These pouring rights, or exclusive contracts with a beverage company, can be held with certain venues and schools are no exception.[93] Within the contracts, it may be outlined where the machines are placed and how many beverages must be sold. In an effort to counter some of the SSBs sold, the USDA requires that SSBs are not sold during lunch periods but some school do not comply. A 2014 study using data from the annual Youth, Education, and Society study (2007-2012) analyzed trends in middle and high school food availability in relation to profits to school districts, commercial vendors, and schools.[94] When a commercial supplier provides products in sell in schools, some schools receive incentives, percentages of food sales, and in some cases suppliers dictate what foods are sold in schools. Findings from the study suggested that profits for schools and companies supplying the foods were associated with higher availability of LNED foods. However, profits for the districts were associated with decreases in LNED foods in schools within the district. Results suggest that more district involvement can promote fewer LNED foods sold in schools, and schools should exercise caution when agreeing to sell products from food companies.

School Policy Implementation. Using the 2010 School Health Profiles study and the CDC report titled *Competitive Foods and Beverages in US Schools: A State Policy Analysis*, a comparison was made between state policies on competitive foods and school nutrition environment.[95] School food environment reported by a weighted representative sample of secondary schools, grades 6 through 12, in 49 states was used via the School Health Profiles study. Principals reported nutrition-related policies and practices which included competitive

foods. The alignment of each state's policies with IOM recommendations was analyzed for the study based in quartiles: Q1 0-25% alignment, Q2 25.1-50%, Q3 50.1-75%, Q4 75.1-100%. No competitive food policies were in effect for 11 states, 19 states were in Q1, 17 states were in Q2, and 2 states were in Q3. SSBs were less available in the higher quartiles but availability of FVs were not increased in the higher quartiles. Similarly, access to SoFAS including chocolate candy, sodas, sports drinks and caffeine decreased as the quartile alignment increased.

Policies are given much credit for the potential to impact obesity rates.[96] Practices in schools vary and are widely monitored by two primary United States surveillance programs: School Health Policies and Practices Study and the School Health Profiles Study. Each of these studies are sponsored by the CDC. The School Health Policies and Practices Study is a nationally representative sample every 6 years. Data is collected at state, district, school and classroom levels. This study compiles information on health and physical education, health services, nutrition services and faculty and staff health promotion. It covers elementary through high school grade levels. The School Health Profiles Study is a state survey that is done every two years. This survey is self-administered that surveys school healthy policies related to many variables ranging from competitive foods and food service to tobacco use and violence. However, it is largely unknown how the policies and practices in place concerning nutrition standards are distributed among difference races, socioeconomic status and location. Although this is widely unknown currently, the national competitive foods mandate will be widespread in schools. Enforcement of the policy will cause another question to arise entirely.

Policies, once in place, are subject to lack of enforcement. A study followed the ECLS-K from 5th (n=11,820 children) to 8th grade (n=9609) from 2004 to 2007 to assess effectiveness of standards.[97] Child responses were used to assess the food environment using the Food

Consumption Questionnaire which asked students about the availability of several items in school: soft drinks, sports drink, fruit drinks, snack items and sweets. State policies were determined by a report from the Trust for America's Health, an annual publication. The study compared policies in place and the resulting reported availability of soft drinks, sweets, low-nutrient snacks and low-fat snacks. Policies were defined as being a limit which regulates the availability of competitive foods in schools based on time or method sold or defined as a standard which regulates the nutrient content. These definitions have been developed by the Trust for America's Health. In spring of 2004 three states had a standard in place, and 11 other states had limits in place. By the year 2007 in spring, 2 additional states introduced a limit, 5 introduced a standard and 12 states introduced both a limit and standard. As a result, about 35% of the sample of children was affected by the newly introduced limits and standards. Findings to note include that the limits introduced did not have a significant impact on the competitive food item availability. However, standards reduced the availability of all competitive foods with the exclusion of low-fat snacks. Low-nutrient snacks had the greatest decrease as a result of implemented standards followed by soft drinks and sweets. The findings suggest that stringent standard implementation may be effective in controlling availability of SoFAS in schools.

In the 2012 School Health Policies and Practices Study, it was found that 38.3% of school districts required that schools prohibit the advertisement of junk foods or fast-food restaurants on school property.[23] Another 27.6% recommended that these advertisements not be permitted. State-level data was collected by means of web-based questionnaires which were completed by state education agencies from all 50 states and the District of Columbia (n=51). District-level data was collected in a similar manner from a nationally representative sample.

These selected respondents were completed by staff with the most responsibility regarding school policies (n=660 districts).

Bill adoption for nutrition policies in schools is dependent on a number of factors which include political, economic and cultural factors for each state.[98] Examining introduction of bills between January 1, 2003 and December 31, 2005 using NetScan's Health Policy Tracking Service found 717 bills for 49 states that applied to childhood obesity prevention. This study researched the bills suggested and what factors impacted the final passing or revoking of bills into legislation. Both bill-level characteristics which were classified as procedure, component and content were examined as well as state-level variables which included sociodemographic, political, economic and industrial factors. Of the sample 17% were enacted (123 bills). Highest percentage of proposed bills enacted in Colorado, Louisiana and Georgia. The highest number of bills enacted was in California and Illinois, each with 10 bills passing. A mere 12 states did not enact any bills between 2003 and 2005. The highest percentage of bills enacted was for areas that included safe school routes, farmer's markets, and walking/biking trails. Fewer bills were enacted in areas that included nutrition standards, course curriculum for health/nutrition/physical education but no bills were enacted for snack/soda taxes or menu/product labeling.

District-Level Policies

District level policies can elicit change in nutrition quality of school meals. In five school districts within two large California and Illinois counties, school meals underwent implemented school meal nutrition interventions (n=973).[99] These interventions were compared to the national standards before and after changes were made. The analyses involved were calories, protein (g), fiber (g), total fat (g), saturated fat (g), sugar (g) and sodium (mg). The nutrition guidelines developed for these districts were based on IOM recommendations or Alliance for a Healthier

Generation. Significant school meal changes were observed: a reduction of calories, sugar and sodium. This study suggests that the implementation of nutrition standards can be successful and calls for policy implementation from the federal level. Although district school policies can elicit change, nationwide, less than 5% of districts met 2010 Dietary Guidelines for Americans recommendations for school policies in a nationally representative sample from 2009-2010 (n=622).[100]

State-Level Policies

State policies have been found to be even more effective at restricting access to SoFAS than district nutrition policies.[26] Using a cross-sectional study design, a nationally representative sample of all school levels was studied to compare availability of competitive foods in vending machines or school stores, specifically SoFAS (n=563 schools). The data were gathered by means of questionnaires targeted at district- and state-level nutrition services. About 93% of high schools had vending whereas 84% and 30% of middle and elementary schools had vending machines. State policies that required prohibition of sales of SoFAS in vending machines or school stores offered significantly less than those schools residing in states without recommended policies or required policies outlining similar standards. Middle schools with policies requiring the prohibition of SoFAS sales in vending/school stores were more effective, nearing statistical significance (p=0.07), than those simply recommending the restrictions.

Comparisons between the stringency of state laws and student weight status have also been done.[101] Using the Classification of Laws Associated with School Students, a database which documents codified laws regarding school nutrition, states were classified with strong, weak or no competitive food policies in 2005. Codified laws are defined as the assembly of written statues, rules, orders, policies and regulations that apply to school food and beverages

regarding nutrient value. These laws were classified on policy strength and how thorough the policies were. These codified laws were compared to the BMIs of children 11-14 years old collected through the 2007 National Survey of Children's Health (n=16,271). Most states did not have middle school competitive food and beverage policies in 2005 (31 states). Of the remaining states with laws, 11 had weak laws and 9 states had strong laws. The strongest laws were similar to *Smart Snacks in School* policies and the weakest were mere recommendations for à la carte nutrition standards. Children living in states with weak policies were 21-23% more likely to be overweight or obese in comparison to children living in states with no or strong laws when multiple covariates were controlled for. These covariates included age, sex, race/ethnicity, television access, sleep, physical activity, family structure and poverty level. Overall the associations with state law stringency and BMI were present but weak.

A cross-sectional study using data from the National Youth Physical Activity and Nutrition Study from the CDC examined the relationship between soda consumption, fast food consumption and source of school lunches compared to state laws on soda availability in school venues.[102] A small significant difference was found in students that had access to vending machines in schools compared to those who did not. Results from the study conclude that 23.9% of students with access to vending machines drink at least one soda per day compared to 27.9% of daily soda consumers without vending machine access. However, it should be noted that students without vending machines also have more lunches obtained neither at school nor from home, suggesting an open campus policy in some schools (5.6% of students getting lunch elsewhere with vending, 7.2% without vending). A primary limitation for this study is that vending machines were not audited for contents, so it is possible that schools with vending

machines did not even offer the soda. Additionally, other sources of soda in schools were not accounted for. For example, sodas could be sold as part of fundraisers or in school snack bars.

Texas State, District and Local Nutrition Policies. An examination of the effects on middle school student eating habits of both local and statewide Texas nutrition policies took place at baseline, after local (school-level) policy implementation and finally after the implementation of the Texas Public School Nutrition Policy.[103] The Texas Public School Nutrition Policy applied nutrition regulations to all foods sold in schools which involved portion restrictions, fat content regulations of foods, and limits on how often certain foods (such as french fries) are served in cafeterias. The assessments took place in 2001-2002 (n=2,671), 2002-2003 (n=5,273), and 2005-2006 (n=10,234) respectively. Foods purchased and brought to school were assessed by means of anonymous food records, collected by trained personnel immediately after lunch. Students were asked what foods were eaten, where the food came from, and how many servings were consumed. Comparing baseline measurements to post-state policy implementation, there were more milk and vegetables consumed and fewer SSBs and snack chips eaten. Vending machines provided fewer SSBs, candy, snack chips, and desserts after the state policy though more of these items were brought from home. Soft drink consumption decreased from baseline to post-state policy dropping from 4.76 to 0.11 ounces per child though 66% of these drinks in year 3 were brought from home compared to 4% at baseline. Other similar significant declines in other SoFAS were seen: candy (0.09 to 0.04 servings/child), dessert foods (0.11 to 0.04 servings/child), snack chips (0.21 to 0.04 servings/child), sweet beverages (5.43 to 1.49 ounces/child). The significant increases in healthy food consumption were also noted: vegetables (0.29 to 0.89 servings/child) and milk (2.44 to 6.54 ounces/child), of these 99% originated from NSLP meals. Another important implication from these policy

changes to note is that the F/R and paid NSLP participation all showed an increase (77%, 127%, and 143% respectively) after state policy implementation.

Another study focusing on the effects of the Texas Public School Nutrition Policy examined consumption of SoFAS in middle school students in two different socioeconomic status groups: medium and low.[104] The medium socioeconomic status school consisted of 40% eligibility for F/R NSLP meals and the low socioeconomic status school had 80% of students eligible for F/R NSLP meals; about 58% of all Texas students in 2007-2008 were eligible for F/R meals. Data for this study was collected using anonymous food lunch records both before the policy implementation in 2001-2002 (n=1718) and after in 2005-2006 (n=6756). In both the low and medium socioeconomic status groups, the intake of calcium and vitamin C increased significantly. In addition, vegetable and milk consumption increased in both groups while SSB consumption decreased. Middle socioeconomic status students consumed more SSBs overall, while low socioeconomic status students consumed more milk. Middle socioeconomic status students brought more SoFAS from home after the policy implementation than the low socioeconomic status students, particularly high-fat vegetables, SSBs, desserts and chips. Both low and medium socioeconomic status student groups were affected by the policy, but each had varying degrees of impact.

California State Policies. Schools are often not entirely compliant with implemented standards. In a 2009 study, the extent of which California competitive food and beverage standards were implemented was examined.[105] The two California policies implemented are SB 12 and SB 965, which address similar standards to the *Smart Snacks in School* policy (under 250 calories per item, less than or equal to 35% calories from fat, no more than 10% from saturated fat, and no more than 35% of weight from sugars). SB 965 bans the sale of soda and some other

SSBs in schools. This study investigated 56 public California schools, grades 9-12 and participants in the NSLP. In 2008, information about the competitive foods and beverages offered in schools was analyzed using the Food and Beverage Environmental Assessment and Monitoring System which is a computer-based tool used in auditing types of competitive foods and beverages on campuses from California assessments and information collected included brand name, flavor, size, and price. Results indicate that all 56 schools sold competitive beverages and 53 sold competitive foods. About 71.0% of beverages sold in school followed the guidelines. 85.7% of schools observed adhered to the 50% mandated implementation of the beverage regulations. Food regulations were followed by 63.7% of schools. No schools were completely adherent to the food or beverage standards.

In another study on California state competitive food standards audited 19 school campuses in 2005 and again in 2008.[106] Schools included kindergarten through 12th grade and more than 72% were eligible for F/R lunches. This study included both foods and beverages. This study used the Food and Beverage Environmental Assessment and Monitoring System and recorded the location and student access of all competitive foods and beverages on campus. Brand, flavor, size and price were recorded. Adherence rates were categorized into foods and beverages based on the SB 12 and SB 965. For overall foods, the adherence rate increased from 23.3% to 67.1% from 2005 to 2008. Beverage policy adherence rates went from 50.3% to 77.8%. All adherence rates by school level increased for foods. For the beverages, all adherence rates in each school level increase, except in schools that included levels kindergarten through 12th grade (drop from 57% to 41%) and middle school (84% to 81%) when compared to elementary and high schools. Food sold in vending machines were less compliant with rules than food sold in

schools stores, researchers propose that this may be due to difficulty maintaining healthy items with potentially shorter shelf lives in vending machines.

Further examination of the effects of California policies on school food environments have been made.[107] One study included 3 studies combined: the Healthy Eating, Active Communities study, the High School Study, and the School wellness Study (n=99 schools). Schools K-12 were included. Each study detailed various aspects of SB 12 and SB 965 compliance, impact of policies on food and beverage purchases, financial impact on schools, perceived benefits from food service directors, and perceived benefits or challenges to standard implementation. Included in the studies were ethnically diverse students (primarily Latino) with many of low socioeconomic status. Student surveys, food and beverage sales, online food surveys for food directors and interviews with school wellness teams were included. Foods available in à la carte, vending, school store, and other competitive food venues were assessed. Overall, schools offered more compliant foods than before the legislation and more beverages were compliant with standards than foods. Sodas were almost eliminated in the schools observed. Chips and candy declined in availability while crackers/pretzels/popcorn and snack mix increased, among other items. Sodas declined drastically while sports drinks increased, similar to national consumption trends. Foods that were more frequently compliant with new standards were baked chips, corn nuts, cereal, yogurt, FVs. However, foods found to be often noncompliant were hot entrees, candy, sweetened fruit snacks, trail mix, cookies and pastries. Student reports reflected fewer students consuming soda and vegetables while more were drinking water at school with statistical significance. Despite increased relative avabiliaity compared to sodas, decreased consumption of sports drinks were noted. Decreased consumption of candy and chips were observed as well as a non-statistically significant increase in milk and

fruit consumption. An overall decline in sales was observed within this study period. The study suggests that policies can impact dietary habits.

In a California study examining nutrition policies, SB 12 and SB 965, the impacts on high school diet were compared to diets of children in 14 states without a similar policy.[108] This cross-sectional study examined high schools and used the National Youth Physical Activity and Nutrition Study (n=680 students) which uses a 24-hour recall to determine diet categorized by location of consumption including school, home and other. California students consumed fewer calories at school than students in other states (21.5% vs. 28.4%) but these results, when adjusted for race differences were not significant. Additionally, more calories were consumed away from school than students in other states (19.8% vs. 14.1%). Although these results suggest that the policies may not be making as large of an impact as once supposed, it is possible that the race differences and adjustments needed may be confounding the data.

Other State Policies. In Michigan, the School Nutrition Advances Kids project focused on the effectiveness of school nutrition policy changes both at the school-level and state-level.[109] Schools that were eligible for the study consisted of 50% or more students on F/R lunches. Baseline was taken when students were in seventh grade and reassessed in eighth grade (n=1176 students) in 55 schools. The Youth Food Frequency Questionnaire was used to assess student diet. Each school, except the control group, was assessed based on nutrition education, policies and environments. Four groups of schools were used: control group which made no changes, schools that implemented an action plan, schools that implemented an action plan and student nutrition team, schools that created both an action plan and a Michigan State Board of Education nutrition policy in their cafeteria for à la carte items. Schools that only had an assessment done and an action plan made experienced a 5.2% increase in fiber, and fruit consumption increased

by 17.3%. Similarly, schools that participated in the statewide nutrition policy increased fiber by 4.9% and fruit by 18.3%. Overall, the schools that made 3-6 policy changes significantly increased their fiber intake by 10.5% and fruit by 30.1%. The conclusions of the study state that new USDA standards for competitive foods will likely increase the nutrient density of foods consumed by students in schools, and perhaps increase fruit, vegetable, and whole grain consumption as well.

A state-level study in Massachusetts of 74 middle and high schools across 36 districts found that more competitive foods and beverages met standards for competitive foods and beverages outlined in a statewide school nutrition bill (105 CMR 225.000).[110] The standards became effective in August of 2012 and before these standards there were none outlined for competitive foods and beverages. These standards are similar to the new *Smart Snacks* standards: limits on calories, portions, saturated fat, sugar and sodium. These standards apply to all school levels and all competitive foods and beverages. A comparison of foods and beverages available to students was done in 2012, before implementation, and 2013. Before implementation, 13.5% of competitive foods and 46.10% of competitive beverages were compliant to the standards. After implementation of the policies 68.80% of foods and 86.50% of beverages were compliant. Researchers conclude that the results emphasize the ability of schools to make changes due to standard implementation and that these changes are feasible.

The School Health Profiles is a nationally representative survey conducted among school principals and lead health educators to evaluate the school environment in all states.[111] According to results from the 2014 School Health Profiles, 67.8% of Virginia middle schools have snack foods and beverages available for purchase which may include chocolate candy (20.5%), other kinds of candy (26.2%), salty snacks (29.1%), baked goods (30.4%) and soda

(28.5%) and sports drinks (44.2%). Merely 45% of all middle schools surveyed in Virginia did not sell these foods and beverages high in SoFAS. Schools were also surveyed about the healthy items offered as competitive snacks including nonfat or 1% plain milk (36.4%), bottled water (65.8%), and 100% juice (48.5%). Only 31.3% and 26.3% of schools always provided fruits and non-fried vegetables at celebrations. Pricing nutritious foods lower than unhealthy items was uncommon, with only 14.3% of schools participating in this practice.

National-Level Policies

Healthy, Hunger-Free Kids Act of 2010. The intention of both the NSLP and SBP are to provide access for children to F/R nutritious meals.[112-114] The NSLP was established to increase and promote consumption of nutritious agricultural commodities. Nearly three decades later the SBP was established complement to the lunch program in order to provide adequate nutrition to students to encourage optimal learning.[114] In 2012, the USDA published nutrition standards to align with IOM recommendations and the most recent Dietary Guidelines for Americans for the NSLP and SBP.[113] Approximately 31 million and 10 million children participate in the NSLP and SBP program each day, respectively.[115] Children are eligible for reduced price meals if the household income is between 130 and 185 percent of the US poverty level. Those over 185 percent of the poverty level are required to pay full price. Those children who are eligible for a free school lunch live in a household at or below 130 percent of the US poverty level. Reimbursements are provided to schools based on the number of qualifying F/R meals sold to students.

Smart Snacks in School. On June 27, 2013, the HHFKA was amended to establish nutrition standards for all foods sold on school campuses, including those outside of the NSLP and SBP, known as competitive foods.[8,9] Competitive foods are foods and beverages sold at any

time during the school day, in or out of the cafeteria, but not part of NSLP or SBP. They are considered competitive foods because they "compete" with NSLP and SBP sales. It is possible that children purchase competitive foods and beverages instead of opting for a NSLP or SBP meal. Sources of competitive foods may be vending machines, school stores, fundraising efforts, and *à la carte* items which are foods sold in the cafeteria outside SBP/NSLP.[10]

New regulations for competitive foods are called *Smart Snacks in School* and came into effect July 1, 2014. *Smart Snacks in School* amends the HHFKA to create standards for all foods sold on school campus during school hours. These regulations, reflecting the most recent Dietary Guidelines for Americans,[116] contain general standards and specific nutrition standards for foods. See Tables 1 and 2 for overviews of the standards in middle schools; foods must comply with both general and nutrient standards. For beverages, middle schools are restricted to plain water (carbonated or non-carbonated), low-fat milk (unflavored), and nonfat milk (includes flavored), milk alternatives with similar nutritional profiles to dairy milk, and 100% fruit or vegetables juice (can be diluted with water or carbonated water). All beverages must be no more than 12 ounces as served.[8] The USDA has issued a memorandum stating that both waivers for the SBP and *Smart Snacks in School* will not be permitted.[117]

Table 1: Summary of Middle School Smart Snacks in School General standards[9]

General Standard: foods must meet one general standard
• A grain product (>50% whole grains by weight OR whole grain as first ingredient*) • Be a fruit (can be dried), vegetable, dairy or protein (meat, bean, poultry, seafood, eggs, nuts, etc.) OR have these as first ingredient* • A combination food with ¼ cup fruit/vegetable • Contain 10% of the Daily Value (DV) of a nutrient of public health concern (Ca, K, vit. D, dietary fiber) until July 1, 2016 (after this will not qualify) *can be second ingredient if first is water

Table 2: Summary of Middle School *Smart Snacks in School* Nutrient standards[9]

Nutrient Standard: foods must meet all nutrient standards		
Nutrient	**Standard**	**Exemptions**
Total fat	≤ 35% total calories from fat as served	Reduced-fat cheese, nuts and seeds, nut/seed butters, dried fruits with nuts/seeds and no added sweetener/fat, seafood with no added fat, part-skim mozzarella cheese
Saturated fat	< 10% of total calories from saturated fat as served	Reduced-fat cheese, nuts and seeds, nut/seed butters, dried fruits with nuts/seeds and no added sweetener/fat, seafood with no added fat, part-skim mozzarella cheese
Trans fat	"zero" grams (< 0.5g) per portion as served	none
Sodium	≤ 230 mg per portion as served (until July 1, 2016) ≤ 200 mg per portion as served (after July 1, 2016)	none
Calories	≤ 200 calories per portion as served	none
Total sugar	≤ 35% of weight from total sugars as served	Dried/dehydrated fruits or vegetables with no added nutritive sweeteners, dried fruits with nutritive sweeteners for processing/palatability, dried fruits with nuts/seeds and no added sweetener/fat
Overall exemptions		
• Fruits (frozen/fresh/canned in juice/light syrup) • Vegetables (fresh/canned with minimal sugar) • Entrée items as part of the NSLP/SBP if it is sold as a competitive food on day of service or day after service in NSLP/SBP (must have ≤480 mg/sodium, ≤350 calories)		

Reactions to Smart Snacks in School. As part of the *Smart Snacks in School* policies, states are responsible for defining "infrequent" fundraisers and may implement standards that are more stringent than the national requirements.[112] States may also create an exemption for the foods and beverages sold as part of the infrequent fundraiser do not have to comply with *Smart Snacks in School* standards. Virginia has created an exemption for fundraisers, which permits no

more than 30 school-sponsored fundraisers per school year.[118] These fundraisers may include items that do not meet the *Smart Snacks in School* guidelines and may be sold in schools during school hours.

Some states are taking additional action to enforce the *Smart Snacks* standards and to strengthen the restrictions. In New Mexico, school vending machines will only sell nuts, seeds, yogurt, cheese and fresh fruit to students in middle and high school and other snacks will not be sold until a half-hour after the school day ends.[119] Maryland House and Senate committee meetings were held in March 2015 regarding a proposed Maryland Health School Snacks and Marketing Act, which would require schools to meet the new *Smart Snacks* standards in addition to marketing limitations in schools.[120] This proposal was met with opposition by the Maryland Association of Boards of Education with oppositions on the grounds that the current regulations are sufficient to establish a healthier school environment.[121]

In response to the standards, some food companies are reformulating products.[122] Suggestions for how companies can reformulate products include additions of FVs for not only nutritional benefit but also for color. Some product reformulations have been labeled as "copycat snacks", created to comply with the guidelines set forth by the USDA in the *Smart Snacks in School* but are not widely offered outside of school.[123] However, similarly packaged items of non-identical nutritional value are available for purchase in local stores and groceries. It is possible that students may misidentify these copycat snacks to be healthy.

Advertised snacks by food companies are most commonly yogurt, savory and sweet snacks.[124] In a 2015 report of snack foods advertised to children, the majority of yogurt products met *Smart Snacks* standards whereas only one-fourth of sweet and savory snacks met the *Smart Snacks* standards. Nut and fruit products were the healthiest products advertised. As part of the

analysis, 270 products sold in schools by nine companies were also evaluated. The yogurt products sold in schools were similar to yogurt products advertised to children and sold in schools. However, the sweet and savory snacks sold in schools were far healthier than similar products advertised to children, further emphasizing the growing concern of copycat snacks.

Parents have also been asked about their opinions on the new standards via a telephone poll of parents registered to vote in the United States (n=1,112).[125] Overall, 72% of polled parents supported the current NSLP and SBP meal standards. In regards to *Smart Snacks in School*, 70% of parents with children in middle or high school supported the increased restrictions on competitive foods and beverages. Support has also been documented in specific states, concluding that many parents advocate the new standards.[126-133]

In response to the *Smart Snacks* standards, schools have made steps to increase healthy food options. Overall, schools have not reported major losses in total revenue and some even report gains in NSLP participation.[134] Further research in various school settings is merited to examine environmental, financial, and behavioral changes that may occur in response to the *Smart Snacks in School* standards. The purpose of this study is to examine the effect of the *Smart Snacks in School* regulation on eight rural middle schools in southwest Appalachian Virginia. Both school food environment and student dietary intake was part of this analysis.

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Chapter 3: The Availability of Competitive Foods and Beverages to Middle School Students in Appalachian Virginia Before Implementation of the 2014 Smart Snacks in School Standards

Abstract

Introduction: The widespread availability of 'competitive foods' during the school day may undermine students' diet quality and contribute to obesity. During the 2014-15 school year, competitive foods, including *à la carte*, frequent fundraisers, vending and school store items, were required to meet the U.S. Department of Agriculture's *Smart Snacks in School* regulations to improve the quality of foods and beverages that compete with national school meal programs. Rural schools may experience unique challenges to implement the *Smart Snacks* standards.

Methods: In 2013, we audited eight rural middle schools in southwest Virginia with more than 50% of students eligible for free or reduced price school meals. The baseline data were collected for the availability of *à la carte* and vending machine items prior to the implementation of the *Smart Snacks* regulations.

Results: More than three quarters of *à la carte* items (85.4% of foods and 76.5% of beverages) met the new nutrition standards. However, two thirds of vending machine items at four of the eight middle schools would require modification or substitution to fully comply with the new beverage standards. The most challenging nutrient targets for schools to meet were $\leq$ 35% of calories from fat and $\leq$ 230 mg of sodium. Snack foods of highest concern were chips, ice cream, cheese crackers, and baked goods.

Conclusion: Future research should assess how competitive foods contribute to students' diet quality during and out of school, and also examine challenges and resources needed to help rural middle schools implement the *Smart Snacks* regulations.

Introduction

The Healthy, Hunger-Free Kids Act of 2010 requires all foods and beverages provided to students through the United States Department of Agriculture's (USDA's) school meal programs to meet specific nutrition standards for public and private schools to receive federal reimbursement for the meals served.[1] 'Competitive foods' are foods and beverages available to students in grades kindergarten through 12 during the school day that compete with the federal School Breakfast and National School Lunch Programs. Beginning the 2014-2015 school year, competitive foods, such as those sold *à la carte*, in vending machines, and school stores, were required to meet the *Smart Snacks in School* regulations that provide nutrient targets for total calories, fat, saturated fat, *trans* fat, sugar, sodium, caffeine, and whole grains.[2]

During the fall of 2014, 49.8 million students attended public elementary and secondary schools in the United States (U.S.), and 35.1 million were in grades pre-kindergarten through 8.[3] The widespread availability of competitive foods during the school day may undermine students' diet quality and contribute to obesity. Competitive foods such as potato chips, candy and sugar-sweetened beverages are often high in total fat, added sugars and salt.[4,5] In 2013, 77% of U.S. middle schools offered *à la carte* items, 53% provided vending machines, and 49% had school stores.[5]

Adolescence is an important time to establish healthy eating habits because weight status during this developmental period is a strong predictor of diet-related chronic diseases, such as type 2 diabetes, heart disease, and certain types of cancer in adulthood.[6] There have been limited school-based interventions that have targeted competitive foods in schools located within high-poverty rural regions and middle school-aged youth, despite evidence that children living in

remote rural areas are disproportionately affected by risk factors that contribute to overweight and obesity.[7-9]

The purpose of this study was to assess the availability and nutritional quality of competitive foods offered through vending and *à la carte* to students attending eight rural middle schools located in a rural Appalachian region of southwest Virginia, prior to the implementation of the *Smart Snacks in School* regulations in July 2014. These standards apply to competitive foods sold in vending machines, school stores, fundraising efforts, and as *à la carte* items.[10] Prior to the *Smart Snacks in School*, no national policies were in place for school snacks and beverages,[11] and availability varied considerably between school districts and states.[12] The research hypothesis for this study was that middle schools will need to replace more than half of the current food and beverage items with heathier options to meet the new USDA's *Smart Snacks* standards based on previous research documenting implementation success of similar state standards in California.[13]

Methods

Setting and Participants

All public middle schools in 22 counties of southwest Virginia located within the Appalachian region and with 50% or more of students eligible for free or reduced price (F/R) National School Lunch Program (NSLP) meals were recruited to participate in this observational study. Students who are eligible to receive free lunches have a household income at or below 130% of the poverty level and students with a household income between 130% and 185% qualify for reduced-price meals.[3] F/R NSLP eligibility rates were based on 2012-2013 school year data from the Virginia Department of Education.[14] In general, Appalachia is considered a

disparate region with low educational attainment, and a long history of poverty with a predominantly white population (90.8%).[15,16] In 2012, the selected counties had higher rates of household poverty (18.8%) compared to the state of Virginia (15.5%)[16] and national rates (15.0%).[17]

The goal was to reach a sample pool of eight participating schools. After randomizing schools into a list of contacts, 11 schools were contacted during the spring of 2014 to participate in the study which represented a 72.7% response rate. School principals were contacted first through email followed by phone calls to be recruited for the study. If a school declined to participate, the next school(s) was contacted on the list. Schools that agreed to participate were provided with a $100 honorarium after completion of the baseline study.

Measures

In the spring of 2014, principals of participating schools were asked about school policies affecting the availability of competitive foods to students in each of the eight schools. Audits of each of eight participating school's *à la carte* and vending items were performed using an adapted protocol for vending machines[4] that recorded each product's brand name, flavor/variety, price, and package size for each pre-packaged item. Each vending machine front slot counted as one item. Only items available exclusively for *à la carte* were audited. Separate nutrition standards applied to the NSLP items and, for this reason, the NSLP items were excluded from the audit. Cafeteria managers assisted in providing information on all *à la carte* inventories of foods and beverages. Nutrition information was obtained directly from the manufacturer through product websites or by requesting information, or information was obtained on the product nutrition label included on the food packaging.

Statistical Analysis

After the nutrition data were obtained for each item available, the nutritional profile for each food and beverage item was compared to the *Smart Snacks in School* standards[1] to determine the number and percentage of items that were compliant with the new standards by food or beverage category (vending and *à la carte)*, by school, and across all participating schools. According to the *Smart Snacks in School* standards, a single serving of food must provide ≤ 200 calories, ≤ 35% calories from fat, < 10% calories from saturated fat, < 0.5 grams *trans* fat, ≤ 230 mg of sodium (200 mg starting July 1, 2016), and ≤ 35% weight from sugar. Foods must follow the macronutrient standards and adhere to one of the following ingredient standards:

1. Be more than 50% whole grain by weight or have whole grain as the first non-water ingredient;
2. Offer a vegetable, fruit, dairy or protein as the first non-water ingredient;
3. Be a combination food containing 1/4 cup fruit/vegetable; or
4. Contain 10% of the Daily Value for calcium, potassium, vitamin D or dietary fiber only until June 30, 2016.

Fat restrictions excluded reduced-fat cheese, nuts, seeds, nut/seed butters, seafood, and part-skim mozzarella. Sugar restrictions excluded dried fruits and vegetables, and trail mixes containing fruits and nuts. Entrée foods used as *à la carte* offerings from the NSLP were exempt from *Smart Snacks in School* standards because these were required to meet the NSLP standards. Beverage standards varied for school levels. In middle schools the only beverages allowed, including water, were less than or equal to 12 ounce servings of low/non-fat milk, non-fat flavored milk, and 100% fruit or vegetable juice.

Smart Snacks in School ingredient regulations include a possible 10% Daily Value standard which exceeds the current Virginia standards.[18] In Virginia competitive foods must minimally meet 5% of the Daily Value for one or more of the following nutrients: vitamin A, calcium, niacin, thiamine, protein, riboflavin, iron, and vitamin C. They must also restrict vending machine hours to only those outside of school lunch hours.[18] No local (school) wellness policies existed within the study schools that further restricted competitive foods and beverages.

F/R rates of schools were compared with percent of items compliant using a linear regression to determine any existing correlations (Microsoft Excel, 2012, Microsoft Corporation, Inc., Santa Rosa . Descriptive statistics on the availability of competitive foods and beverages were determined by competitive food category (*à la carte and* vending) and compared to new standards defined in *Smart Snacks in School* (Microsoft Excel, 2012, Microsoft Corporation, Inc., Santa Rosa, CA).[1] The percent of food and beverage items compliant with the new policies were described by standard and by school.

Results

School Sample

Four of the eight participating schools included more than grades six through eight: three included kindergarten through eighth grade, and 1 included grades five through eight. The average eligibility rate for F/R lunch was 57.0% (range 51.0%-63.0%); there were no significant differences between participating and nonparticipating schools. More than 93% of students were white. None of the principals indicated that there were any school-level policies that influenced the availability of competitive foods.

Vending Machines

Of the eight surveyed schools, four had vending machines. Of these, two schools offered only water, one offered water and juice in less than 10 ounce portions and one offered water and sports drinks, which were not compliant with the *Smart Snacks in School* standards. Considering the number and availability of vending machines, these data are not reported in detail here.

À La Carte Items

Overall, 36.6% of all à la carte foods and 78.2% of à la carte beverages in each school met all the Smart Snacks in School standards (Table 1). No correlation was observed between number of items offered or compliance and eligibility for F/R lunch. The most popular snack items sold were potato chips, flavored tortilla chips, and other salty snacks. Chips, grain-based desserts, and ice cream often did not meet the standards; however, granola bars and sweet snack mixes did.

Table 1. Compliance of à la Carte Foods and Beverages With *Smart Snacks in School* Standards, Schools With High Rates of Students Eligible for the Free or Reduced-Price National School Lunch Program, Appalachian Virginia, 2014

School Number	% of Students Eligible for Free or Reduced-Price Lunch	No. of à la Carte Foods Offered[a]	% of Foods Compliant With Standards	No. of à la Carte Beverages Offered[b]	% of Beverages Compliant With Standards
1	51.0	6	16.7	2	50.0
2	51.6	9	55.6	3	66.7
3	56.0	9	22.2	2	100.0
4	56.9	8	25.0	4	75.0
5	58.2	5	40.0	1	100.0
6	59.6	25	36.0	9	66.7
7	59.8	7	42.9	5	80.0
8	63.0	13	53.9	8	87.5
Mean school compliance (95% confidence interval)	—	10.3 (5.8–14.7)	36.5 (26.6–46.5)	4.3 (2.2–6.3)	78.2 (66.2–90.3)

Abbreviation: —, not applicable.
[a] Foods offered include exempted food items (eg, part skim cheese).
[b] The same beverage offered in a different size was counted as a separate beverage.

Common beverages included bottled water (32.4%), carbonated and noncarbonated 100% juice (41.2%), and fruit drinks (23.5%). Some schools offered 5% fruit drinks, which are not permitted under the Smart Snacks in School standards. The most challenging standard to meet was 35% or less calories from fat (62.3%; standard deviation [SD], 19.2%) (Table 2). A high percentage of schools (94.7%; SD, 10.5%) complied with the sugar standard in their foods (≤35% sugar by weight), and most (77.6%; SD, 22.1%) adhered to the saturated fat standard (≤10% saturated fat). Most schools (71.9%; SD, 21.5%) met the 200 calories or less per serving standard.

Table 2. Schools in Compliance with Smart Snacks in School Standards for à la Carte Foods, by Nutrient Category Standard, Appalachian Virginia, 2014

School Number	% of Students Eligible for Free or Reduced-Price Lunch[a]	Foods Meeting Smart Snacks in School Standards							
		≤200 Calories	≤35% Sugar by Weight	≤35% Calories From Fat	<10% Calories From Saturated Fat)	<0.5g Trans Fat	≤230 mg Sodium	Ingredient Standards	All Standards
1	51.0	50.0	100.0	33.3	100.0	100.0	66.7	83.3	16.7
2	51.6	77.8	100.0	55.6	100.0	100.0	66.7	77.8	55.6
3	56.0	100.0	100.0	44.4	44.4	100.0	100.0	77.8	22.2
4	56.9	37.5	100.0	50.0	62.5	100.0	50.0	100.0	25.0
5	58.2	60.0	100.0	80.0	80.0	100.0	40.0	80.0	40.0
6	59.6	72.0	72.0	80.0	80.0	100.0	60.0	88.0	32.0
7	59.8	85.7	85.7	85.7	100.0	100.0	71.4	85.7	42.9
8	63.0	92.3	100.0	69.2	53.9	100.0	100.0	92.3	53.9
Average compliance by school, % (SD)	—	71.9 (21.5)	94.7 (10.5)	62.3 (19.2)	77.6 (22.1)	100.0	69.3 (21.5)	85.6 (7.7)	36.0 (14.5)
Average compliance by food item, % (SD)	—	74.4	90.2	65.9	75.6	100.0	70.7	86.6	36.6

Abbreviation: SD, standard deviation; —, not applicable.

[a] Values are percentages unless otherwise noted.

Compliance with individual standards by schools and by food items was similar but not identical. Some schools offered more food items than others (Tables 1 and 2). Most foods (85.6%; SD, 7.7%) met ingredient standards and 36.6% of competitive food items were compliant with all Smart Snacks in Schools standards.

Discussion

Findings validated the stated hypothesis that at least 50% of items would need to be replaced with reformulated or alternative foods and beverages, because 63.4% of à la carte and vending machine food items did not meet the new standards.[8] Fat and sodium restrictions proved to be the most difficult standards to achieve, and items included flavored tortilla chips and ice cream novelties (fat) and chips, cheese crackers, and baked goods (sodium). Food items that failed to meet the caloric restrictions often met the other standards, with the exception of serving size. Most food items met the sugar restriction except ice cream novelties. Over 85% of foods met the additional ingredient standards which meant foods had to meet one of the following requirements: be more than 50% whole grain by weight or have whole grain as the first non-water ingredient, have a vegetable, fruit, dairy or protein as the first non-water ingredient, be a combination food with ¼ cup fruit/vegetable, or contain 10% of the Daily Value of calcium, potassium, vitamin D or dietary fiber. Many ice cream items had dairy as a first ingredient and many sweet and salty snacks were at least 50% whole grain. Foods that failed the additional ingredient standards were most often flavored tortilla chips. Based on data from the vending machines, only one school would need to change vending offerings based on the new standards, which does not align with our hypothesis.

The number of items offered à la carte did not correlate with the percentage of eligibility for F/R lunch in schools, in contrast to literature showing lower purchasing power for competitive foods among students who are eligible for F/R meals.[9-11] Each county in the study offered different numbers and types of foods and beverages even within the same region. Some offered more chips than others and some schools offered many types of ice cream, demonstrating the level of diversity across schools, even within the same geographic and cultural region. Still,

some consistencies were evident. Most schools had chips and ice creams and some offered doughnuts, cereal, and baked goods. Item variety offered in comparison to previous research implied that more of the schools in the present study provided ice cream; fewer provided sugar-sweetened choices and similar sweet and salty snack options.[12] The primary limitations of this study were the small school sample size and lack of external validity.

Future research should investigate the impact of the *Smart Snacks in School* policies on the availability of competitive foods and beverages; how competitive foods contribute to students' diet quality and intake during and out of school, and their weight status. Potential effects on school nutrition revenues and participation in the NSLP should also be studied. Further analysis of the school nutrition education curriculum could also be beneficial to understand how changes occurring in rural middle schools and the national school meal programs could be adapted to maintain consistency with the new nutrition standards. Qualitative studies are also needed to elicit feedback from school administrators, nutrition directors and students about the opportunities, challenges and resources needed to help rural middle schools implement the *Smart Snacks* regulations.

The primary limitations of this study were the small school sample size and limited generalizability of the sample, and the pre-existing state-level policies that may limit student access.

This baseline audit of eight rural schools in southwest Virginia found that the most challenging nutrient target to meet was the total fat standard. About two thirds (63.4%) of competitive food items in these schools will require modification or substitution with healthier options to be fully compliant with the new standards. Rural schools with limited resources will

likely require technical assistance and supplemental funding to be fully compliant with the USDA's *Smart Snacks in School* standards for the 2014-2015 school year.

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Chapter 4: Middle School Compliance with National Nutrition Standards for Competitive Foods and Beverages Available to Students in Southwest Virginia

Abstract

Background: Competitive foods and beverages provided *à la carte*, in vending machines, as fundraisers, and in school stores were required to meet the U.S. Department of Agriculture's *Smart Snacks in School* nutrition standards effective July 1, 2014. This study examined foods and beverages available for purchase by students in vending machines and *à la carte* to evaluate compliance in rural Appalachian Virginia middle schools before and after implementation of the federal regulation.

Methods: Eight middle schools with higher than 50% of student eligibility for free or reduced priced lunches were included in the sample pool. Audits of food and beverage products sold in vending machines and *à la carte* were completed in spring of 2014 and 2015.

Results: All *à la carte* beverages adhered to the new standards compared to only two thirds (65.5%) of vending machine beverages. School compliance for offering *à la carte* foods increased from 36.0% to 90.0%. Fat, sodium, and additional ingredients were the most difficult nutrition standards for schools to meet.

Conclusions: While compliance of Appalachian middle schools in Virginia improved between 2014 and 2015 to meet the *Smart Snacks* regulation, rural schools will require additional training and technical assistance to fully implement nutrition standards.

Background

The Healthy, Hunger-Free Kids Act of 2010 required all foods and beverages provided to students in public and private schools participating in school meal programs to meet nutrition standards to receive federal reimbursement for the meals served.[1] Beginning July 1, 2014, competitive foods which include *à la carte* items, vending machines, fundraisers and school stores, were required to meet the *Smart Snacks in School* regulation with nutrient targets for calories, fat, saturated fat, *trans* fat, sugar, and sodium. Foods must adhere to at least one of the following specific ingredient standards: be more than 50% whole grain by weight; have whole grain as the first non-water ingredient; have a vegetable, fruit, dairy or protein as the first non-water ingredient; be a combination food containing 1/4 cup fruit/vegetable; or contain 10% of the Daily Value for calcium, potassium, vitamin D or dietary fiber (only until June 30, 2016). Foods must also be ≤ 200 calories, ≤ 35% calories from fat, < 10% calories from saturated fat, < 0.5 grams *trans* fat, ≤ 230 mg of sodium (200 mg starting July 1, 2016), and ≤ 35% weight from sugar. Exemptions are in place for reduced-fat cheese, nuts, seeds, nut/seed butters, seafood, and part-skim mozzarella. Sugar restrictions excluded dried fruits and vegetables, and trail mixes containing fruits and nut. Entrée items sold the day of or day after meal served are exempt from *Smart Snacks* standards as they adhere to separate National School Lunch Program (NSLP) standards.

Although the NSLP has strict standards, competitive foods were unregulated at the national level before *Smart Snacks in School* and often high in total calories, fats, added sugars and sodium, which may increase the risk of child and adolescent overweight and obesity.[2,3] The food environment can influence students' dietary behaviors, depending on the availability food and beverage items.[4]

Adolescents' weight status is a strong predictor of adult overweight and obesity, which affects more than two-thirds of adults in the United States.[5,6] Few studies have analyzed the nutritional profile of competitive foods in isolated rural middle schools, where changes in food availability have the potential to affect a high-risk population.[7,8]

The objective of this study was to assess and compare the availability and nutritional quality of competitive food and beverage products in vending machines and *à la carte*, including the number of items sold as *á la carte* from NSLP, in eight rural Appalachian Virginia middle schools before and after implementation of the *Smart Snacks in School* regulation.[1] We postulate that: 1) implementation of the *Smart Snacks in School* regulations will improve overall nutritional quality of competitive foods and beverages available for purchase by middle school students in high-poverty area rural southwest Appalachian Virginia between 2014 and 2015; but 2) 100% of competitive foods and beverages will not be compliant with the new nutrition standards.

Methods

Participants

Eight public middle schools in southwest Appalachian Virginia with a 50% or more student eligibility to participate in the free or reduced price (F/R) NSLP were recruited for this cross-sectional observational study.[9] Participating schools were contacted from a randomized list of schools where three of eleven schools contacted declined to participate (72.7% response rate). Data were collected in spring of 2014 (prior to implementation of new standards) and the spring of 2015 (approximately six months following implementation).

Instrumentation

School vending machines and *à la carte* items were audited using an adapted protocol for vending machines. Further details on the audit methodology are documented in a baseline report.[10] We recorded the product brand name, flavor/variety, price and package size. School food records were obtained to determine number of meals sold as part of the NSLP, entrées sold *á la carte*, and total number of á la carte items sold. School principals were also asked if any changes in local school wellness policies for competitive foods and beverages occurred between spring of 2014 and spring of 2015.

Procedure

Nutrition information was compared to the *Smart Snacks in School* standards for total calories, fat, added sugars, sodium and ingredient standards, which are more restrictive than Virginia's state standards.[11,12] The percent of food and beverage items compared to the new policies were described by venue, standard, and school.[1] Cafeteria managers provided items sold reports for six days: the day before, day of, and day after audits prior to and after implementation to evaluate if more NSLP items were being sold as *á la carte* after implementation of the standards. These reports included total items sold as á la carte, total entrées sold, and number of entrées sold as á la carte.

Data Analysis

Descriptive statistics were computed for the eight schools' F/R eligibility and for snack items that adhered to the *Smart Snacks in School* standards, including proportion. A two-tailed paired t-test (Microsoft Excel, 2012, Microsoft Corporation, Inc., Santa Rosa, CA) at the $p = .05$ level was used to determine differences between baseline compliance rates and post-implementation compliance. Proportions of entrées sold á la carte were compared to the number

of meals sold for each school. Entrées sold as á la carte were also compared to overall á la carte items sold. In all schools, three days of meal records were compared using a paired t-test (Microsoft Excel, 2012, Microsoft Corporation, Inc., Santa Rosa, CA).

Results

School Characteristics

Average F/R eligibility rate was 57.0% (range 51.0-63.0%) and four of eight schools included more than grades six through eight with three including grades kindergarten through eighth grade. One school included fifth grade. More than 93% of students were white and schools were demographically similar.[10] and no local wellness policies to guide competitive food and beverage sales were identified by school principals.

Vending Machines

In the baseline audit, only four schools had vending machines with all schools offering water. One school offered juice in 10 ounce portions and another had non-compliant sports drinks. After implementation in July 2014, one school had added vending machines that offered flavored water and diet sports drinks that did not meet the nutrition standards. No other vending machine offerings were added or withdrawn and are not analyzed here. There was no significant change in compliance of vending machine beverages pre- and post-implementation of the *Smart Snacks* standards ($p = 0.40$).

Á la Carte

All *à la carte* beverages offered in schools were compliant with the new standards compared to baseline, where an average of 78.2% of beverages adhered to the standards across schools ($p = 0.009$). However, fruit beverages were offered that did not meet the new standards.

Beverages that were compliant with the regulation included water, 1% fat chocolate milk, 100% juice and 100% sparkling juice.

Overall the gain in compliance from *à la carte* foods in each school was 54.9% (SD 18.4%), a significant increase from 36.0% to 90.0% compliance averaged across all schools (p = 0.0001). Compliance of *à la carte* foods in schools ranged from 66.7% to 100% compliance. Of the 8 schools audited, 5 schools increased the number of items offered and the remaining 3 offered fewer *à la carte* items. The number of food items offered ranged from 5 to 25 at baseline and 3 to 17 post-implementation (Table 1).

Table 1. Summary of *à la Carte* Foods and *Smart Snacks in School* Compliance with *Smart Snacks in School* in Schools with High Rates of Students' Eligibility for the Free or Reduced Price National School Lunch Program in southwest Appalachian Virginia in 2014 and 2015

% of Students Eligible for Free or Reduced-Price Lunch*	Number of *à la carte* foods offered†		Compliance with new standards (% of total)		Change in Percent Compliance (% of total)
	Baseline	Post-Implementation	Baseline	Post-Implementation	
51.0%	6	17	16.7	100.0	83.3
51.6%	9	11	55.6	100.0	44.4
56.0%	9	10	22.2	90.0	67.8
56.9%	8	18	25.0	94.4	69.4
58.2%	5	3	40.0	66.7	26.7
59.6%	25	9	32.0	88.9	56.9
59.8%	7	10	42.9	100.0	57.1
63.0%	13	10	53.9	80.0	26.2
Mean school compliance (95% CI)	10.25 (5.5-15.0)	11 (7.5-14.5)	36.0 (26.6-45.4)	90.0 (81.7-98.3)	54.9 (41.2-66.7)

Abbreviation: CI, confidence interval; —, not applicable.
*Values are percentages unless otherwise noted
†Foods offered include exempted food items (e,g., part skim cheese)

More foods met the calorie ($p = 0.02$), fat ($p = 0.003$), saturated fat ($p = 0.02$), and sodium ($p = 0.004$) standards across the eight middle schools. All schools met the no greater than 0.5 grams of *trans* fat per serving as well as the standard of ≤ 35% of sugar by weight (Table 2). Six schools were entirely compliant with the ≤ 200 calorie/serving requirement. Foods sold that failed to meet the new standards included corn chips, salty snack mixes, baked goods, and ice cream novelties (Figures 1 and 2). Average compliance across schools for the ≤ 35% calories from fat standard was high (96.7%; SD, 4.9%) compared to baseline (62.3%; SD, 19.2%). Most food items (96.6%) met the ≤ 10% calories from saturated fat. Two schools were neither

compliant with the sodium standard (< 230 mg per portion as served) (94.4%; SD, 11.9%) nor the ingredient standards, with 66.7% and 88.9% of foods in these schools that met the ingredient standards. All other schools were fully compliant with ingredient standards.

Before implementation of the standards the mean percent of entrées sold á la carte compared to meals sold was (15.29%; SD 8.62%) and post-implementation was (15.02%; SD 7.73%). Differences in proportions for foods sold the day before audits ($p = 0.79$), day of audits ($p = 0.56$) and day after audits ($p = 0.78$) were not significant. Similarly the differences in proportions for foods sold á la carte compared to overall á la carte items sold the day before audits ($p = 0.78$), day of audits ($p = 0.48$) and day after audits ($p = 0.41$) were not significant. Of all á la carte foods sold, (28.12%; SD 21.40%) and (29.26%; SD 19.55%) were entrées sold pre- and post-implementation respectively as á la carte.

Table 2. School Compliance with *à la Carte* Foods by Nutrient Category Standard of the *Smart Snacks in School* Standards in southwest Virginia in 2014 and 2015

% of Students Eligible for Free or Reduced-Price Lunch*	≤200 calories, % of total		≤35% sugar by weight, % of total		≤35% calories from fat†, % of total		<10% calories from saturated fat, % of total		<230 mg sodium, % of total		Ingredient standards, % of total		All, % of total	
	Baseline	Post-	Baseline	Post-	Baseline	Post-	Baseline	Post-	Baseline	Post-	Baseline	Post-	Baseline	Post-
51.0%	50.0	100	100	100	33.3	100	100	100	66.7	100	83.3	100	16.7	100
51.6%	77.8	100	100	100	55.6	100	100	100	66.7	100	77.8	100	55.6	100
56.0%	100	100	100	100	44.4	100	44.4	90.0	100	100	77.8	100	22.2	90.0
56.9%	37.5	100	100	100	50.0	94.4	62.5	100	50.0	100	100	100	25.0	94.4
58.2%	60.0	66.7	100	100	80.0	100	80.0	100	40.0	66.7	80.0	66.7	40.0	66.7
59.6%	72.0	88.9	72.0	100	80.0	88.9	80.0	100	60.0	88.9	88.0	88.9	32.0	88.9
59.8%	85.7	100	85.7	100	85.7	100	100	100	71.4	100	85.7	100	42.9	100
63.0%	92.3	100	100	100	69.2	90.0	53.8	80.0	100	100	92.3	100	53.9	80.0
Average compliance by school (SD)	71.9 (21.5)	94.4 (11.9)	94.7 (10.5)	100	62.3 (19.2)	96.7 (4.9)	77.6 (22.1)	96.3 (7.4)	69.3 (21.5)	94.4 (11.9)	85.6 (7.7)	94.4 (11.9)	36.0 (14.5)	90.0 (11.7)
Average compliance by items	74.4%	97.7 %	90.2%	100 %	65.9%	96.6 %	75.6%	96.6 %	70.7%	97.7 %	86.6%	97.7 %	36.6%	93.2 %
T-test P value	$p = 0.02$		NS		$p = 0.002$		$p = 0.02$		$p = 0.004$		NS		$p = 0.0001$	

Abbreviation: SD, standard deviation; NS, not significant.

*Values are percentages unless otherwise noted
†All foods pass the <0.5 *trans* fat standards

Discussion

All schools improved the nutritional quality of the food and beverage items offered in vending machines and sold as *à la carte* but they were not all schools were fully compliant, supporting our proposition that not all food and beverage items would fully comply with the new *Smart Snack* standards.[13] The fat, sodium and additional ingredient standards were the most difficult for schools to meet and not all schools were fully compliant with the ≤ 200 calorie/serving requirement. Portions of salty snacks were often too large and salty snacks and chips often did not meet ingredient standards. Chips and baked goods were too high in fat and ice cream often did not meet the saturated fat restriction. Similar studies have documented a high prevalence of salty snacks and baked goods sold in schools,[14] and baked goods (grain desserts) are a top contributor to empty calories to young people's diet.[15] All *à la carte* beverages met the new standards, as found in other research.[16] Beverages offered in vending machines varied and were not as compliant with the *Smart Snacks* regulations (23.67%; SD 27.02%) across schools with vending machines. Only four schools offered beverages in vending machines and two of the four sold beverages that were not compliant with the standards.

Figure 1. Types of foods beverages offered as *à la Carte* and in southwest Appalachian Virginia middle schools in 2014 before *Smart Snacks in School*

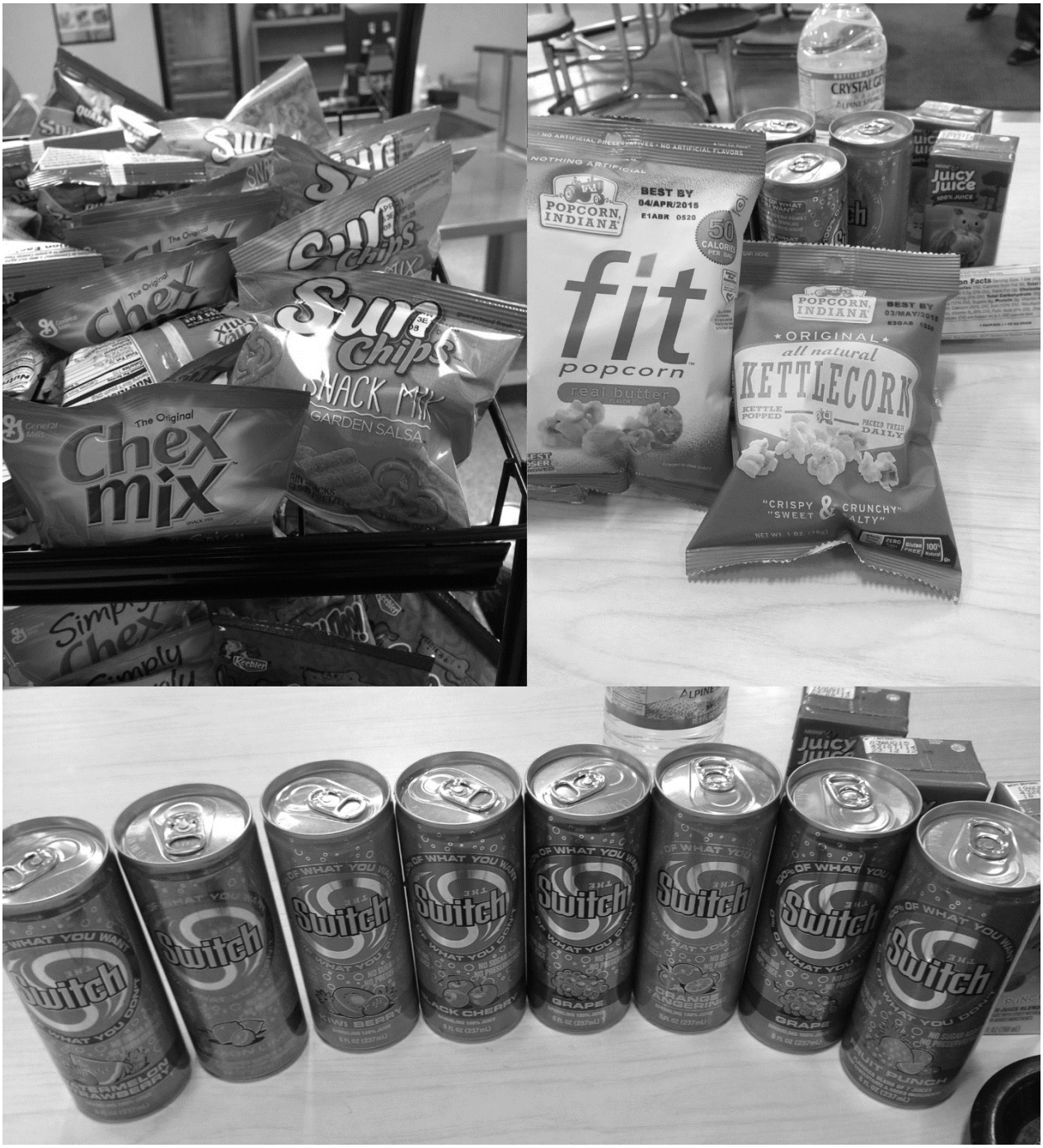

Figure 2. Types of foods beverages offered as *à la Carte* and in southwest Appalachian Virginia middle schools in 2015 after *Smart Snacks in School*

More than 94% of foods met the additional ingredient standards which included one of the following: offer more than 50% whole grain by weight or have whole grain as the first non-water ingredient; provide a vegetable, fruit, dairy or protein as the first non-water ingredient; offer a combination food with ¼ cup fruit/vegetable; or contain 10% of the Daily Value of calcium, potassium, vitamin D or dietary fiber. Only until 2016 foods can meet 10% of the Daily Value of the aforementioned nutrients in order to comply with the additional nutrient standards.[1] Overall, school compliance for providing food items that met the nutrition standards was 90% (SD 11.7%) across schools. In contrast, national data indicates that 95% of school districts nationwide are compliant with the new nutrition standards.[17] Only three schools of the eight included in this study offered *à la carte* foods that were fully compliant with the *Smart Snacks* standards. This compliance rate with the new snack standards is lower than Virginia's compliance rate of 95.6% to the NSLP nutrition standards.[18]

Cafeteria managers were eager to comment on the new standards both for competitive foods and NSLP, anecdotally stating that the standards were strict and students often threw whole fruits and vegetables away. Some managers commented that students simply did not like vegetables or there was too much whole wheat in the lunch menu. Very few comments directly related to the *Smart Snacks* regulation, though several noted the difficulty in finding snacks that were as popular as other options higher in solid fats and added sugars such as chips and ice cream novelties. Some cafeteria managers noted several positive changes made such as baking or steaming all their foods. A few commented that, despite complaints at first, students are eating better than before the standards. Managers reported using successful strategies to implement the standards such as cutting up fruits and vegetables into small portions, purchasing novel packaging such as water bottles with drinking caps, and putting small amounts of cheese on

vegetables to make dishes more attractive to students. A few managers found great success in providing students with pre-packaged popped popcorn, small bags of salty snacks, and compliant reformulated ice cream novelties. It is possible that cafeteria managers are not in compliance because they struggle to find foods that students will purchase or perhaps they had difficulties finding alternatives and only sold what was available to them. The nutrition standards are complex, and it is also possible that cafeteria managers may believe that they are compliant with standards but are failing to meet the stringent requirements.

While all food items did not meet the new standards, schools have the potential to influence the diet of low-income middle-school students.[19] Southwest Virginia was selected based on the high level of poverty in the region where associations among rural living, food insecurity and obesity have been documented.[20,21] Similar to baseline audits, F/R eligibility did not correlate with the number of food items offered in each school which contrasts literature showing that students who participate in the F/R NSLP make fewer *à la carte* purchases or consume less competitive foods.[22-24]

Several food and beverage companies are continuously reformulating their products to meet the *Smart Snack* standards. However, one independent evaluation reported that 'copycat snacks' that had similar packaging to those sold in schools were available to children and adolescents to purchase at local grocery stores, and were higher in calories, total fat and salt.[25] Some students could misidentify these copycat snacks to be healthy. Future research should explore students' perceptions and the impact of these copycat snacks on adolescent's purchases and diet quality.

Limitations

It is possible that the differences in F/R rates in this study are too marginal to show a difference, or there are too few schools in the sample. Every school district offered different numbers and types of foods and beverages, demonstrating the level of diversity across schools even in a similar geographic and cultural region. This study cannot be generalized to other schools outside of the Appalachian community, but is imperative to help improve the food and beverage environment within this highly disparate impoverished area of the U.S.

Conclusions

New *Smart Snacks in School* competitive foods standards in schools improved the food environment in middle schools in rural Appalachian Virginia and could potentially affect student diets. However, despite positive changes, schools may need additional assistance to fully implement the nutrition standards.

Future studies should also investigate the impact of the *Smart Snacks in School* policies on school revenue, student weight status, and how competitive foods contribute to students' diet quality and intake during and out of school. It is also important to examine school nutrition education curriculum, which could encourage a shift in social norms in rural schools. Feedback from school administrators, nutrition directors, cafeteria managers and students would also help to identify specific challenges in policy implementation. It will be important to understand the reasons for why some schools remain resistant to implementing the *Smart Snacks in School* regulation.

Implications for School Health

While compliance of Appalachian middle schools in Virginia improved between 2014 and 2015 to meet the *Smart Snacks* regulation, rural schools will require training and technical

assistance to fully implement the new nutrition standards. Schools may need additional assistance utilizing and categorizing foods in the Smart Snacks calculator,[26] which many cafeteria managers anecdotally noted using despite many products not meeting the standards in their respective schools. School staff should be made aware of resources such as the Action for Healthy Kids Report which provides more details on how to evaluate foods.[27] It may be beneficial to provide managers with hard copies, as many find the use of computers challenging and obtrusive in these rural areas. Currently the USDA provides technical assistance grants, but many cafeteria managers may be unaware of these grants. Peer-to-peer training may also be highly valuable within the school districts. School local wellness policies, as established in the WIC Reauthorization Act of 2004 are subject to yearly reporting, but schools primarily set goals for policies.[28] Principals of schools in this study reported that the wellness policies created for these schools did not concern competitive foods. Schools are not required to create a wellness policy specifically concerning compliance of national meal/competitive foods standards.[29] We suggest that schools adopt, monitor and evaluate local wellness policies that encourage compliance with national nutrition standards.

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Chapter 5: Smart Snacks in School Legislation Does Not Change Self-Reported Snack Food and Beverage Intake of Middle School Students in Rural Appalachian Region

Abstract

Background: In July 2014, national *Smart Snacks in School* legislation mandated nutrition standards on competitive foods and beverages in schools participating in National School Lunch and/or Breakfast. These foods and beverages include items sold outside of the national meal programs. The study purpose was to assess effects of these standards on student food and beverage intake in rural Appalachian middle schools.

Methods: Food frequency questionnaires were administered to sixth-grade students before and sixth- and seventh-grade students after implementation in schools with 50% or more eligibility for free or reduced price National School Lunch meals. Multiple ordinal logistic regression models were conducted to examine effects from year, grade, and free or reduced price lunch participation rates. Separate analyses were run on consumption frequencies in and outside of school.

Results: A decrease in consumption of 1% or nonfat flavored milk at school was found after implementation, however no other significant changes were observed after implementation of the standards. Higher free or reduced price lunch eligibility rates were positively correlated with consumption of vegetables, ice cream, and low or non-fat frozen desserts, juice, and milk at school. Free or reduced price lunch rate was negatively correlated with consumption of soda outside of school.

Conclusion: *Smart Snacks in School* standards did not result in significant dietary changes in this study, neither in nor outside school. Schools were not fully compliant to standards,

demonstrating existing barriers to implementation of national standards. Longitudinal studies may help evaluate long term impacts of nutrition standards on student diet.

Introduction

Children and adolescents from the age of 5 to 17 years old spend the majority of their waking hours in school settings and consume 35 to 40% of their daily calories in schools.[1] Schools are important avenues to promote healthy eating among transitioning adolescents to become independent purchasers, when long-term risk of obesity may persist.[2]

School competitive foods are foods and beverages sold in vending machines, school stores, as *à la carte* and as fundraisers. More than 60% of middle schools offer competitive foods, which are generally energy dense and often high in solid fats and added sugars (SoFAS).[3] In July 2014, the *Smart Snacks in School* regulation took effect, and amended the Healthy, Hunger-Free Kids Act of 2010 to create nutrition standards for all foods and beverages sold in schools, based on the Institute of Medicine recommendations and Dietary Guidelines for Americans.[4,5]

The goal of this study was to examine the effect of this policy on snack food and beverage intake of adolescents within rural Appalachia, especially considering that low socioeconomic status and rural lifestyle are tied to lower dietary quality and higher obesity rates.[6,7] Despite the high poverty levels in the Appalachian region of the United States, few studies exist that examine the dietary quality and behaviors in this region.[8] The hypothesis was that implementation of *Smart Snacks in School* would improve dietary quality of middle school students in rural Appalachian middle schools.

Methods

Sample

Schools in southwest Appalachian Virginia with 50% or more of students eligible for free or reduced price (F/R) National School Lunch Program (NSLP) meals were recruited to participate in this study in spring of 2014 (before implementation) and spring of 2015 (after implementation). Further details describing response rates and selection of schools are reported elsewhere, as well as audit data on school competitive foods and beverages offered for sale to students before implementation of the *Smart Snacks in School* standards.[9]

Participants

Questionnaires were administered to approximately 45 sixth-grade students in each school before implementation. After implementation, survey instruments were administered to approximately 45 seventh-grade and 45 sixth-grade children per school. Students surveyed were determined by principals of participating schools. Often the required number of students was fulfilled by gym classes or individual classes of students. Sample size was determined based on a desired 80% probability that the study will successfully detect differences in student diets before and after implementation determined by a minimal detectable difference of 0.22 servings (SD 1.504 servings). Only sixth-graders were selected prior implementation as these students would be first exposed to more competitive foods in comparison to seventh-grade students. Both sixth- and seventh-graders were included in after implementation analysis to assure that changes by grade were not significantly affecting any possible changes observed before and after implementation. It is possible that students surveyed before implementation also participated in the survey after implementation.

Questionnaire

The survey instrument consisted of socio-demographic questions, including grade, gender, and frequency of lunch purchases; and the Beverage and Snack Questionnaire 2 (BSQ2). The BSQ2 is a modification of the BSQ, with the addition of flavored milk, water, and coffee/tea, designed for children 10-18 years old.[10,11] The questionnaire focuses on the consumption of snack foods and beverages, particularly those high in SoFAS and fruits and vegetables, that are often found in competitive food venues.[10,12] The original BSQ was tested for validity with results ranging from 0.11-0.69 across food types (snacks, fruits/vegetables, etc.) when compared to a 4-day food record.[10,13] Reliability coefficients ranged from r=0.72 to r=0.85 per item.

Participation was voluntary and no personal information was obtained. Parental consent was not required for the anonymous survey. Study instruments and protocol were approved by the Virginia Polytechnic Institute and State University Institutional Review Board.

Data Analysis

In order to conduct an ordinal logistic regression model with year, grade (six and seven), and F/R rate as covariates, responses for frequency of consumption for all 23 food and beverage items were coded as never or less than once per week (0), 1 per week (1), 2-4 per week (2), 5-6 per week (3), 1 per day (4), 2-3 per day (5), and 4 or more times per day (6). Three separate analyses were conducted for frequency of consumption in school, since one school did not permit any socio-demographic data to be collected due to sensitivity issues. The three analyses allowed for the testing of effects of different socioeconomic variables on dietary intake both in school and outside of school: 1) a model including seven schools to determine effects of gender, grade, time and F/R rate; 2) a model including all eight schools including time, grade, and F/R rate; and 3) a model using seven schools comparing diet and school lunch purchase frequency

with school treated as a random effect (SPSS Statistics V 22.0.0, 2013 IBM Corporation, Armonk, NY).

Results

Participants

Average enrollment for the eight participating schools was 104 sixth-grade students (range 70-156 students) and 116 seventh-grade students (range 60-160 students) in the 2013-2014 school year (before implementation) and 115 sixth-grade students (range 59-149 students) and 103 seventh-grade students (range 66-161 students) in the 2014-2015 school year (after implementation).[14] The study sample included 416 sixth-grade students before and 304 sixth and 363 seventh-grade students after implementation. Of the seven schools with gender data, 54% of respondents identified as male. Overall 89.2% of the sample self-identified as white, 3.0% identifying as African American, 1.1% as Asian or Pacific Islander, 1.6% as Native American, and 3.2% identifying as other; 1.9% preferred not to answer. Of this sample, 2.31% identified as Hispanic or Latino.

Self-Reported Snack Food Intake At School

The foods with the highest consumption frequencies were: fruit (23.3% of students consumed 1 or more servings per day); vegetables (13.9%); chips (10.1%); candy (8.5%); and baked goods (7.4%). Students who reported buying lunch were also more likely to report eating vegetables and consuming salty snacks. Females reported consuming less low or non-fat frozen desserts and ice cream ($p < 0.05$) and higher fruit consumption than males.

There were no differences in snack food consumption patterns over time. Additionally, no significant differences in consumption of foods or beverages were found between sixth-grade

before implementation and sixth-grade after implementation. Similarly, no significant differences were found between sixth-grade before implementation and seventh-grade after implementation for either foods or beverages, in or out of school.

Several differences were noted between schools. For example, regular chips were consumed more often by students in school six and less often by students in school seven ($p < 0.01$). Additionally, F/R eligibility rate by school was positively associated with both low or non-fat frozen desserts and ice cream consumption ($p < 0.05$). It was also positively associated with increased vegetable consumption ($p < 0.01$).

Self-Reported Snack Beverage Intake at School

The most frequently consumed beverages reported were: water (39.1% of students consumed 1 or more servings per day); 1% or non-fat flavored milk (17.1%); regular or 2% flavored milk (13.2%); 100% juice (13.4%); and regular or 2% unflavored milk (10.6%). Few students reported consumption of energy drinks, coffee or tea. In contrast, fruit drinks, sports beverages, flavored water and soda consumption were negatively associated with school lunch purchases. Frequency of consumption of all milk varieties except regular or 2% unflavored milk was positively associated with buying lunches both before and after implementation. Significantly more females reported more frequent consumption of plain water ($p < 0.01$) while males consumed more 100% juice ($p < 0.01$), energy drinks and 1% or non-fat flavored milk ($p < 0.001$).

A higher consumption of 1% or nonfat flavored milk occurred before *Smart Snacks* implementation ($p < 0.05$) with more flavored water consumed after implementation of the policy ($p < 0.05$), but no other effects or changes were noted.

Again, differences existed between schools with school eight consuming the most 100% juice and school three consuming the least ($p < 0.05$). A higher F/R rate was associated with increased 100% juice consumption ($p < 0.05$), 1% or nonfat flavored milk ($p < 0.01$), regular or 2% flavored, 1% or nonfat unflavored, and regular or 2% unflavored milk ($p < 0.01$). Frequency of consumption of all milk varieties except regular or 2% unflavored milk was positively associated with buying lunches both before and after implementation.

Self-Reported Snack Food and Beverage Intake Outside of School

The snack foods with the highest consumption frequency were: fruits (37% of students consumed 1 or more servings per day); vegetables (25.8%); candy (20.8%) and chips (20.5%). The most commonly consumed beverages were: water (48.6%); soda (29.3%); fruit drinks (22.7%); and sports drinks (22.6%). Similar gender differences were found outside as in school. Females reported a higher consumption frequency of vegetables ($p < 0.01$) as well as higher consumption frequency of fruits ($p < 0.001$) than males. Females also reported higher water ($p < 0.001$) and coffee ($p < 0.01$) consumption than males. Males, however, reported higher energy drink ($p < 0.001$) and 1% or non-fat flavored milk consumption ($p < 0.01$) than females.

No significant changes were noted in snack food and beverage intake outside of school from before to after the implementation. F/R rate was negatively correlated with consumption of soda ($p < 0.05$) and positively correlated with regular or 2% flavored milk consumption outside of school ($p < 0.001$).

Discussion

Our study found that the *Smart Snacks in School* standards did not result in significant shifts in dietary components of middle school students in our sample of rural Appalachian

middle schools - both in and outside of school. The only significant change was that consumption of 1% or nonfat flavored milk decreased after the legislation, possibly a negative consequence, considering that only 22% of males and 15% of females ages 9-13 are meeting the adequate intake for dietary calcium.[15]

It is possible that while the school snack food environment changed positively, children may have brought foods from home. Additionally, not all school foods were compliant with the standards, still offering an opportunity for students to access unhealthy foods. In another study compliance of á la carte foods to new snack legislation in this sample of schools rose from 36.0% to 90.0%. However, many schools in that study had fundraisers and snack stores open to students.[16]

There were few changes to dietary patterns as a result of the standards which could be explained by the introduction of 'copycat' snacks. 'Copycat' snacks appear similar to 'regular' products found on the market, but are often smaller portion sizes and lower in fat, sodium or sugar available only at school, with the intent purpose of meeting *Smart Snacks in Schools* legislation.[17] Copycat snacks generally include chips, fruit snacks, baked goods and salty snacks. Without knowing there are 'copycat snacks' and the possible nutrient differences, students would not be able to discriminate between reformulated and original products in the BSQ2. The survey includes low-fat and full fat options but it is unlikely students can discern the difference between reformulated and original products due to similarities in packaging. Along these same lines, students may have consumed fruits and vegetables in less healthy forms such as fried, packed in syrup or included in combination dishes such as casseroles. The BSQ2 instrument has examples of vegetables (salad, peas, green beans or corn) and fruits (bananas, apples or grapes) but only excluded fried potatoes and fruit juices. This BSQ2 did provide some common competitive food

and beverage items but was not comprehensive and is based on self-reported data. It is possible that the instrument was not sensitive enough to detect changes in solid fats and added sugars sold in schools. Many of the foods were not substituted with different food types, but instead with the 'copycat' snacks. Despite these limitations, the BSQ2 was an appropriate tool for the age group, and the only known questionnaire verified for this age group that included items often sold in schools.[13]

Due to concerns of privacy, one school did not permit the inclusion of socio-demographic information within the study. The school sample size is relatively small, and schools varied even within the same district. Schools also faced turnover of cafeteria and office staff which could have affected results presented here. For example, one school added non-compliant flavored water vending machines when a new principal was hired. While this report fills an important research gap by studying rural high-poverty middle schools in this unique highly disparate area, it is not widely generalizable.[8]

Snack Foods

Chips were one of the more popular snacks among children participating in the study. Chips as well as baked goods such as cookies were frequently offered in cafeterias as á la carte options.[16] While vegetable and fruit consumption was often reported, children are not meeting their recommended intake of fruits and vegetables.[18]

Consumption patterns of students were reflective of their school food environment, with highly variable food options even within school districts.[19] Association of F/R rate and foods served with NSLP meals is likely attributed to participation in NSLP, which has very strict standards. A higher F/R rate was associated with increased consumption of fruits and vegetables which could be due to higher NSLP participation a trend noted by other research.[20] Both

vegetable consumption and salty snack consumption was positively associated with a higher rate of self-reported lunch purchases, emphasizing the vegetable component of the school meal and availability of salty snack foods sold alongside the school meals as á la carte. Students may be purchasing these items to supplement their school lunches.[21] Another interesting finding was that F/R rate was positively correlated with the consumption of fruit, ice cream, and low or nonfat frozen desserts. Dessert items were often offered alongside of the school meal.

Gender differences in consumption frequency included higher fruit consumption by females and higher ice cream consumption by males. High fruit consumption by females and higher ice cream consumption by males has been found in other studies and is consistent with these data.[22,23]

Snack Beverages

While 1% or nonfat flavored milk declined between baseline to after implementation, students also reported more frequent consumption of flavored water. Decreases in 1% or nonfat flavored milk consumption frequency from before to after implementation could be attributed to decreased NSLP program participation over time.[24] Milk consumption could have declined as a result of increased flavored water consumption, displacing typical milk consumption.

Water, flavored milk, regular or 2% unflavored milk, and 100% juice were the most frequently consumed beverages at school. Similar to snack foods, a higher F/R rate was associated with higher consumption of 100% juice and milk which are beverages included in a NSLP meal.

All milk varieties were positively associated with F/R rate. All milk varieties except regular or 2% unflavored milk was positively associated with frequency of school meals

purchased during the week. It is likely that most of the milk consumed by students was included in their NSLP meal but some students may have confused the many milk options on the BSQ2.

A common beverage offered á la carte by all schools participating in this study was 100% juice.[16] Some schools offered more brands and varieties of juice and had higher consumption rates compared to other schools offering as few as one brand of juice á la carte with no juice in vending or school stores.

Fruit drinks, sports beverages, flavored water and soda were negatively associated with school meal purchases. None of these items were offered as á la carte, but sports beverages and flavored water were offered in vending machines outside of the school cafeterias in select schools. A high report of sport beverage consumption reported in school six where four non-diet sport beverage vending machines were available to students as well as a school store with these items available for purchase. Access to such school stores have been associated with increased sugar-sweetened beverage consumption.[25] Lower sports beverage and soda consumption was reported in schools without sales outside of á la carte.

Higher water consumption by females and higher milk consumption by males is consistent with national study findings.[26] Higher frequency of juice consumption in males could be explained by the high frequency of water consumption in females, suggesting that water displaced 100% juice and milk consumption in their diets. Furthermore, lower energy drink consumption in females has been found elsewhere.[27]

Outside of School

An interesting finding in the present study was that a higher F/R rate was negatively correlated with the consumption of regular soda outside of school. There are several possible contributors to this. While low income families tend to consume more sugar-sweetened

beverages, high NSLP participation may have a spillover effect on healthy eating outside of the lunchroom.[28] Another possible explanation is that parents who elect to have their children enrolled in the NSLP may be more inclined to have a healthier eating environment at home. It is likely that the F/R rate and milk consumption correlation is positive due to students becoming accustomed to drinking flavored milk. Gender consumption patterns were similar to in school consumption patterns.

Conclusions

Consumption frequency of foods and beverages often sold as competitive foods did not change significantly with the implementation of the new *Smart Snacks in School* standards. However, significant differences in consumption frequency of foods sold as part of the NSLP meals varied by F/R rate of schools. Future research should compare school compliance levels to NSLP standards and competitive foods standards on student diet quality. It may also be prudent to study student diet quality over a longer period of time and examine effects of school competitive food policy on weight status.

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Chapter 6: Conclusions

Childhood obesity is a growing concern with health, financial, social, and psychological implications. Previous research indicates strong predictors of obesity to be consumption of solid fats, added sugars which were common in competitive food offerings in schools prior to national *Smart Snacks in School* standards.

Effects on School Food Environment

The nutritional profiles of foods and beverages offered for sale as á la carte and vending at all schools in this study demonstrated improvements, however the standards for fat, sodium and additional ingredient standards were challenging to meet, parallel to national trends.[1-3] What was perhaps the most significant and interesting finding was that although more food and beverage items per school were compliant with the standards after implementation in 2014, no school in this study was fully compliant with the standards as some schools offered fundraisers and additional school stores. This finding highlights the difficulty in translating policy and standards to practice. This difficulty is not the first of its kind, as schools have also struggled to implement local school wellness policies as well as creating acceptable school meals to meet the National School Lunch Program (NSLP) standards.[4,5] There are several possible contributors. First, it could be unintentional and simply a lack of understanding of what can or cannot be sold. When interviewed, managers expressed frustration comprehending the standards, finding foods that students would like and that complied with the standards. Second, cafeteria managers may be resistant to full compliance for fear of revenue loss, especially since all schools were located in high poverty areas where managers noted difficulties in meeting budgets when planning school meals and snacks.[6] Revenue loss could potentially come from a decline in sales of

competitive foods and/or higher costs of compliant items. Cafeteria managers may have feared student complaints about new meals and possible objections from staff as resistance to new initiatives is to be expected but generally decreases over time.[7,8]

Another interesting finding from this study was that most food products that met standards were reformulations of similar snacks sold during the baseline analysis, such as salty snacks, cookies and ice cream novelties. Schools did not substitute foods that did not meet the guidelines with different types of foods (e.g. different food groups), but rather sold similar types of products that were modified by manufacturers specifically to meet the new standards. Ideally, salty snacks would have been replaced with other more nutrient-dense options such as nuts, fruits, or vegetables. Still, some products that were available prior to policy implementation were still available as á la carte, contributing to incomplete compliance with the standards. Beverages were generally limited to milk, 100% juice and water, though one school added vending machines with non-compliant zero-calorie flavored water and one school continued to offer sports beverages to students.

In this study the number of entrée items sold as á la carte did not differ from baseline to post-implementation, and it is unlikely that cafeteria managers are selling more entrees as á la carte to generate revenue. While this was not a strategy used in this study to generate revenue, it is possible that cafeteria managers would make more entrée items with the intention of selling more as á la carte to compensate for a lack of available items non-compliant to national standards in other schools outside of this study.

Effects on Student Diet Quality

Few dietary changes were noted between baseline and post-implementation, based on the food frequency questionnaire used, the Beverage and Snack Questionnaire 2 (BSQ2). At school, foods that were frequently consumed included fruits, vegetables, chips, candy and baked goods. Candy was often offered in school stores or in fundraisers as well as large portion sizes of nuts, trail mixes, and sugar-sweetened beverages. One school still had a school store after implementation of the standards with non-compliant sports drinks and snack foods. Fundraiser food and beverages often do not need to be compliant with the *Smart Snacks in School* standards as Virginia schools are permitted 30 fundraisers lasting an unspecified amount of time, which are exempt from the standards.[9]

One of the hypothesized reasons for not showing any changes was a combination of the instrumentation and the reformulation of products initiated by the standards and carried out by large and small food companies alike. While the nutritional profile of foods improved, the packaging of the food items did not make reformulations obvious and sometimes indistinguishable from previous formulations.[10] The BSQ2 did distinguish between, for example, original tortilla chips and lower fat tortilla chips, however in many instances, the packaging appeared similar between the 'original' and 'reformulated' products, which could have also been confusing to students. The BSQ2 did not distinguish between package sizes which changed from baseline to post-implementation to meet calorie restrictions outlined in the standards. The BSQ2 was selected because it was a valid and reliable instrument for the target age group and included many of the items sold in schools. We believed that changes in schools would be between food types which likely would have been detected though this was not the case in this study. In order

to make changes in student dietary habits, it is imperative to fully implement standards and offer foods that will foster a shift in dietary components of students.

It is likely that larger shifts in student's diets would be noted with a change in the types of foods offered, such as adding fruits for sale as á la carte or offering vegetable snack packs with dips. Cafeteria managers may be hesitant to stock such items due to unknown student acceptance rates, large portion sizes of whole fruits, and shortened shelf life.[7]

Correlations between high free or reduced price (F/R) lunch rates of schools and frequency of consumption of common NSLP food and beverage items were noted, as schools with high F/R lunch rates reported higher intakes of fruits, vegetables, 100% juice and milk. Other food items that were significantly correlated with higher F/R rates included ice cream and low or nonfat frozen desserts, which were common á la carte offerings.

Implications for Policymakers

The *Smart Snacks in School* standards were successful in this sample of schools at improving the nutritional profile of snacks offered during the school day, however the actual types of food did not shift substantially from before the standards to after the standards. Additionally, self-reported diets did not improve significantly. More information is needed to understand how schools select foods and beverages available for purchase to students, what barriers exist to offering more nutrient-dense foods and beverages, what products have been developed for schools by industry that meet the standards, and student preferences within the school setting. Research studies involving interviews with parents, teachers, and school staff indicated positive beliefs that schools are appropriate targets for healthy food.[7] Some perceive federal standards to be barriers to increasing fruit and vegetable intake, however. Standards

should include more guidance and incentives for the sale of vegetables and fruits such as increased reimbursement rates for full NSLP compliance.[11,12] This may mean introducing new ways to serve these products through the provision of more sophisticated packaging (i.e. modified atmosphere packaging) to accommodate for the shortened shelf life of healthier foods such as fruits and vegetables compared to more shelf-stable heat-treated foods. Other options may include pre-sliced apples or baby carrots in individual packages to increase convenience and entice sales, however these products are often more expensive.[13] Implementing similar incentives to those provided in Connecticut with the Healthy Food Certification program[12], where full compliance with competitive foods standards similar to *Smart Snacks in School* allowed for additional money in NSLP reimbursements, may be beneficial. The program not only impacted availability of healthy competitive foods in schools, but also resulted in increased NSLP participation, high food acceptability rates and less food waste.[14] The Fresh Fruit and Vegetable Program is a government program which reimburses high poverty elementary schools for providing fresh fruits and vegetables outside of the national meal programs and has been successful increasing fruit and vegetable consumption in participating schools.[15] The national Farm to School program may also provide options to add local produce to school cafeterias.[16] It seems that incentive programs are very effective at creating healthier school environments rather than simply eliminating unhealthy foods.

More information is also warranted to understand how these policies may impact schools in lower income areas. Schools in high poverty areas may be under more stress to keep a tight budget and have little staff, making it more difficult to take time for training and access to other technical assistance to support policy changes.

Policies have been effective for decreasing availability of unhealthy items in schools regardless of socioeconomic status, but schools in wealthy areas seem to adapt to standards more easily than schools in high poverty areas. Low education rates in Appalachia may shed light on why staff may lack necessary training to offer meals that meet the standards compared to more affluent areas.[17] In particular, schools in high poverty areas may need additional incentives to provide healthy foods.[11,18] Within states it may be helpful to create school partnerships so successful schools can share their techniques with struggling schools.[19,20] Districts may need to provide more insight and suggestions for acceptable foods and help cafeteria managers when selecting products to sell in schools. Perhaps with more support and training for school staff, nutritious and appetizing foods can be presented in schools.

Finally, in Virginia, more restrictive policies concerning fundraising may be warranted. Virginia has created an exemption policy for fundraisers, 30 per school year, but the number of days per fundraiser is unclear.[9] Clarity is paramount so as not to compete with the *Smart Snacks in School* standards. Districts should also seek to actively enforce standards while identifying possible barriers faced by schools to ensure full compliance is made feasible, particularly for schools in high-poverty areas.

Implications for School Nutrition Professionals

Cafeteria managers face the monumental task of balancing food offerings with nutrition standards, student preferences, social and cultural norms, and strict budgets. For school nutrition to be successful it is imperative to reach out to parents, teachers and fellow staff to emphasize the importance of good student health to glean support in and outside of the school environment. Parent polls have demonstrated support for nutrition standards.[21] Inviting parents to help with

implementation, fundraising ideas and perhaps hosting a parent night may help to mitigate the negative stigma that healthy foods and beverages carry within some communities.[3,22] Success in increasing student interest in fruits and vegetables has be documented with various strategies including tasting sessions with novel fruits and vegetables, longer lunch periods, high produce quality, and requesting student involvement in menu planning.[23]

Implications for the Food and Beverage Industry

Many food and beverage companies have responded quickly to the *Smart Snacks in School* standards with product reformulations to align with the standards,[24] yet changes have not extended to other food outlets such as local stores or gas stations.[10] Children and adolescents may unknowingly choose foods sold outside of schools with similar packaging but different, less healthy, formulations as in schools. Ideally, these products would also be available in other settings. Student acceptance of these reformulated products should be assessed, similar to other studies that show acceptance of new school lunches.[25]

School partnerships with large food and beverage companies may help schools financially and many offer a wide range of compliant items to offer for sale.[26,27] However, careful consideration should be taken with advertisements in school walls.[28] Marketing can have a strong effect on children's and adolescent's dietary behavior. Industry-initiated changes have shown improvement, but loopholes exist where further changes need to be made.[29,30] In Virginia advertisements for solid fats and added sugars were restricted in school buildings in over 70% of schools in 2014, but advertisements are not prohibited in all schools.[3,31,32]

Implications for Researchers

Further research is needed to fully understand barriers that exist to implementing the *Smart Snacks in School* regulation. Longitudinal studies will be useful to determine how standards are implemented over time in this particular region of Appalachia. In-depth interviews with cafeteria managers may be helpful to determine perceived barriers to offering healthy foods to students. Effects of 'copycat' snacks on student perceptions of healthfulness of foods will also contribute to efforts to create desired shifts in dietary components of students. Public policy is only one avenue to help mitigate the childhood obesity epidemic in the U.S. Research must be completed to fully understand the complex interrelationships identified by the socio-ecological model, including interpersonal relationships encompassing culture.

Future research that contributes to the understanding of how behavior change can occur in this community can help to create a targeted intervention.[33] While rural Appalachia is a high poverty area, barriers to serving healthy food options may be distinctly different than barriers in urban schools.[34] Appalachia is not only dissimilar due to the mountainous geography, but the culture is also unique to the area.[17] Adolescents in rural Appalachia face higher obesity risks than urban adolescents.[35] Appalachia hosts a culture that reflects a general acceptance of unhealthy weight status even at a young age.[36] Cultural norms surrounding foods, feeding behaviors, beliefs and values are strongly linked.[37] In Appalachia a feeling of belonging is embedded within the community and outsiders are not often trusted, including medical practitioners and, perhaps in this case, policymakers.[38]

When designing interventions, particularly in Appalachia where a strong sense of place exists, it is necessary to involve the community.[37,38] Schools are only one area that can foster healthy change, in order to fully create dietary shifts it is imperative to influence the community

and interpersonal level. This includes changes within families, values surrounding food, and food culture of Appalachia. Networking within the community is imperative, and offers valuable connections and perspectives that can break down identified barriers to shifting cultural and social norms.

Final Conclusions

The nationally mandated *Smart Snacks in School* regulation is a positive step in helping to create healthy school settings for children in order to establish healthy eating habits for a lifetime. Middle school is a critical time period when children are transitioning to adolescents and making more decisions for themselves. Our study provided important insight into how this regulation impacted high poverty rural schools in Appalachian Virginia. Additional research is needed to explore school-level barriers to policy implementation, impact of standards on NSLP participation and school revenue, and effects of school policies like *Smart Snacks in School* on student weight status.

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Appendices

Appendix A: IRB Approval Letters

VirginiaTech

Office of Research Compliance
Institutional Review Board
North End Center, Suite 4120, Virginia Tech
300 Turner Street NW
Blacksburg, Virginia 24061
540/231-4606 Fax 540/231-0959
email irb@vt.edu
website http://www.irb.vt.edu

MEMORANDUM

DATE:	November 18, 2015
TO:	Elena L Serrano, Georgianna Rhodes Mann, Dr. Kathryn Hosig
FROM:	Virginia Tech Institutional Review Board (FWA00000572, expires July 29, 2020)
PROTOCOL TITLE:	Effect of a New Nationally-Mandated Healthy Competitive Foods Policy on Middle School Students' Dietary Intake
IRB NUMBER:	**13-1136**

Effective November 17, 2015, the Virginia Tech Institution Review Board (IRB) Chair, David M Moore, approved the Continuing Review request for the above-mentioned research protocol.

This approval provides permission to begin the human subject activities outlined in the IRB-approved protocol and supporting documents.

Plans to deviate from the approved protocol and/or supporting documents must be submitted to the IRB as an amendment request and approved by the IRB prior to the implementation of any changes, regardless of how minor, except where necessary to eliminate apparent immediate hazards to the subjects. Report within 5 business days to the IRB any injuries or other unanticipated or adverse events involving risks or harms to human research subjects or others.

All investigators (listed above) are required to comply with the researcher requirements outlined at:

http://www.irb.vt.edu/pages/responsibilities.htm

(Please review responsibilities before the commencement of your research.)

PROTOCOL INFORMATION:

Approved As:	**Expedited, under 45 CFR 46.110 category(ies) 7**
Protocol Approval Date:	**December 16, 2015**
Protocol Expiration Date:	**December 15, 2016**
Continuing Review Due Date*:	**December 1, 2016**

*Date a Continuing Review application is due to the IRB office if human subject activities covered under this protocol, including data analysis, are to continue beyond the Protocol Expiration Date.

FEDERALLY FUNDED RESEARCH REQUIREMENTS:

Per federal regulations, 45 CFR 46.103(f), the IRB is required to compare all federally funded grant proposals/work statements to the IRB protocol(s) which cover the human research activities included in the proposal / work statement before funds are released. Note that this requirement does not apply to Exempt and Interim IRB protocols, or grants for which VT is not the primary awardee.

The table on the following page indicates whether grant proposals are related to this IRB protocol, and which of the listed proposals, if any, have been compared to this IRB protocol, if required.

Office of Research Compliance
Institutional Review Board
North End Center, Suite 4120, Virginia Tech
300 Turner Street NW
Blacksburg, Virginia 24061
540/231-4606 Fax 540/231-0959
email irb@vt.edu
website http://www.irb.vt.edu

MEMORANDUM

DATE: April 1, 2015

TO: Elena L Serrano, Georgianna Rhodes Mann, Dr. Kathryn Hosig

FROM: Virginia Tech Institutional Review Board (FWA00000572, expires April 25, 2018)

PROTOCOL TITLE: Effect of a New Nationally-Mandated Healthy Competitive Foods Policy on Middle School Students' Dietary Intake

IRB NUMBER: **13-1136**

Effective April 1, 2015, the Virginia Tech Institution Review Board (IRB) Chair, David M Moore, approved the Amendment request for the above-mentioned research protocol.

This approval provides permission to begin the human subject activities outlined in the IRB-approved protocol and supporting documents.

Plans to deviate from the approved protocol and/or supporting documents must be submitted to the IRB as an amendment request and approved by the IRB prior to the implementation of any changes, regardless of how minor, except where necessary to eliminate apparent immediate hazards to the subjects. Report within 5 business days to the IRB any injuries or other unanticipated or adverse events involving risks or harms to human research subjects or others.

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(Please review responsibilities before the commencement of your research.)

PROTOCOL INFORMATION:

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Per federal regulations, 45 CFR 46.103(f), the IRB is required to compare all federally funded grant proposals/work statements to the IRB protocol(s) which cover the human research activities included in the proposal / work statement before funds are released. Note that this requirement does not apply to Exempt and Interim IRB protocols, or grants for which VT is not the primary awardee.

The table on the following page indicates whether grant proposals are related to this IRB protocol, and which of the listed proposals, if any, have been compared to this IRB protocol, if required.

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Institutational Review Board
North End Center, Suite 4120, Virginia Tech
300 Turner Street NW
Blacksburg, Virginia 24061
540/231-4606 Fax 540/231-0959
email irb@vt.edu
website http://www.irb.vt.edu

MEMORANDUM

DATE: February 5, 2014

TO: Elena L Serrano, Georgianna Rhodes Mann, Dr. Kathryn Hosig

FROM: Virginia Tech Institutional Review Board (FWA00000572, expires April 25, 2018)

PROTOCOL TITLE: Effect of a New Nationally-Mandated Healthy Competitive Foods Policy on Middle School Students' Dietary Intake

IRB NUMBER: **13-1136**

Effective February 5, 2014, the Virginia Tech Institution Review Board (IRB) Chair, David M Moore, approved the Amendment request for the above-mentioned research protocol.

This approval provides permission to begin the human subject activities outlined in the IRB-approved protocol and supporting documents.

Plans to deviate from the approved protocol and/or supporting documents must be submitted to the IRB as an amendment request and approved by the IRB prior to the implementation of any changes, regardless of how minor, except where necessary to eliminate apparent immediate hazards to the subjects. Report within 5 business days to the IRB any injuries or other unanticipated or adverse events involving risks or harms to human research subjects or others.

All investigators (listed above) are required to comply with the researcher requirements outlined at:

http://www.irb.vt.edu/pages/responsibilities.htm

(Please review responsibilities before the commencement of your research.)

PROTOCOL INFORMATION:

Approved As:	**Expedited, under 45 CFR 46.110 category(ies) 7**
Protocol Approval Date:	**December 16, 2013**
Protocol Expiration Date:	**December 15, 2014**
Continuing Review Due Date*:	**December 1, 2014**

*Date a Continuing Review application is due to the IRB office if human subject activities covered under this protocol, including data analysis, are to continue beyond the Protocol Expiration Date.

FEDERALLY FUNDED RESEARCH REQUIREMENTS:

Per federal regulations, 45 CFR 46.103(f), the IRB is required to compare all federally funded grant proposals/work statements to the IRB protocol(s) which cover the human research activities included in the proposal / work statement before funds are released. Note that this requirement does not apply to Exempt and Interim IRB protocols, or grants for which VT is not the primary awardee.

The table on the following page indicates whether grant proposals are related to this IRB protocol, and which of the listed proposals, if any, have been compared to this IRB protocol, if required.

Appendix B: Recruitment Letter to Schools

Dear (School Principal Name),

My name is Georgianna Mann and I am a PhD student at the Virginia Polytechnic Institute and State University (Virginia Tech). I am currently conducting my research on competitive (snack) food and beverage policies in schools.

I am interested in examining the effects of the new policy *Smart Snacks in School* which will regulate all competitive foods sold on school campuses starting July 1, 2014. I would like to request your school's participation as part of our study.

As part of the survey we will, with your permission, audit school vending machines which includes gathering information on the contents and taking photographs. Additionally we will look at a la carte options as part of the school lunch program. For each pre-packaged item, information about product information, including brand name, price, and package size, number of servings per package, calories per serving, fat grams per serving, and sugar grams per serving will be recorded and/or obtained directly from the manufacturer. For non-packaged a la carte items, information will be recorded for each product offered on the day of study, including the number displayed, product description, and portion size, with nutrient information then requested from the School Nutrition Director.

Additionally we would like to ask students to participate in confidential surveys about their dietary intake. This questionnaire will consist of questions on the following: socio-demographic information; dietary intake; snack foods and beverage intake, and weight/height status. Surveys should not take more than 10 minutes to complete. They are very short.

Students will include 45 6th graders per school during spring 2014 (prior to implementation of the policy); and 45 6th and 45 7th graders in spring 2015 (one-year later and following implementation). We would like to survey the same students from 2014 (6th) to 2015 (7th). Students will be randomly selected by class and teachers will be asked for consent. Each class that participates will receive $100 as an honorarium for the teacher to use for his or her classroom.

We will not release any information that could identify students, your school, or your school district. We will be happy to share the information we gather through the study upon request.

Your participation is completely optional. We appreciate your consideration. Should you have any questions please do not hesitate to contact myself at gmann89@vt.edu.

Appendix C: Letter to Parents

Dear [redacted] parents/guardians,

My name is Georgianna Mann and I am a PhD student at the Virginia Polytechnic Institute and State University (Virginia Tech). I am currently conducting my research on competitive (snack) food and beverage policies in schools.

I am interested in examining the effects of the new policy Smart Snacks in School which will regulate all competitive foods sold on school campuses starting July 1, 2014.

As part of the survey we will audit school vending machines, a la carte options and other foods sold on campus. Additionally we would like to ask students to participate in ***anonymous*** surveys about their dietary intake. This questionnaire will consist of questions on the following: socio-demographic information; dietary intake; snack foods and beverage intake, and self-reported weight/height status. Surveys should not take more than 10 minutes to complete. They are very short and your child can opt not to take the survey if they wish.

Students will include 45 6th graders per school during spring 2014 (prior to implementation of the policy); and 45 6th and 45 7th graders in spring 2015 (one-year later and following implementation). We would like to survey the same students from 2014 (6th) to 2015 (7th) if at all possible. Students will be randomly selected by class and teachers will be asked for consent. For Fort Chiswell Middle School we will likely survey during P.E. class. This study has been approved by the VT IRB (13-1136).

We will not release any information that could identify students, your school, or your school district. We will be happy to share the information we gather through the study upon request.

Your participation is completely optional. We appreciate your consideration. Should you have any questions please do not hesitate to contact myself at gmann89@vt.edu.

Sincerely,

Georgianna Mann

Georgianna Mann
Graduate Student
Human Nutrition, Foods and Exercise
Virginia Polytechnic Institute and State University
gmann89@vt.edu

Appendix D: Diet Survey

School Lunch ID: _____

Demographics and Background Information
Adapted from the Catch Kids Club After-School Student Questionnaire

1. How old are you? _____years
   - ☐ 10
   - ☐ 11
   - ☐ 12
   - ☐ 13

2. Are you a boy or girl?
   - ☐ Boy
   - ☐ Girl

3. How do you describe yourself? (Select one or more responses.)
   - ☐ White
   - ☐ Black or African American
   - ☐ Asian or Pacific Islander
   - ☐ American Indian or Alaskan Native
   - ☐ Other
   - ☐ Prefer not to answer

4. Are you Hispanic or Latino? Select one.
   - ☐ Yes
   - ☐ No

5. What is your weight (pounds)? _____ pounds

6. What is your height (feet and inches)? ____ feet _____inches

7. How do you describe your weight? Select one.
   - ☐ Very underweight
   - ☐ Slightly underweight
   - ☐ About the right weight
   - ☐ Slightly overweight
   - ☐ Very overweight

Which of the following are you trying to do about your weight? Select one.
   - ☐ Lose weight
   - ☐ Gain weight
   - ☐ Stay the same weight
   - ☐ I am not trying to do anything about my weight

8. Are you eligible for free or reduced price lunches?
   - ☐ Yes
   - ☐ No
   - ☐ Don't know

9. How often do you buy lunch at school?
   - ☐ Never/Less than once per week
   - ☐ Once per week
   - ☐ 2-4 times per week
   - ☐ 5-6 times per week

10. How often do you buy breakfast at school?
   - ☐ Never/Less than once per week
   - ☐ Once per week
   - ☐ 2-4 times per week
   - ☐ 5-6 times per week

Beverage and Snack Questionnaire 2

Adapted from original by Network for a Healthy California

This questionnaire asks a few questions about the food you ate over the past week.

Please think about what you ate during the past week, while you were at school, and while you were not at school. Not at school includes all of the rest of the time, for example when you are at home, at a friend's house, or at a restaurant.

You are going to mark the column that shows, on average, how many times you ate the food at school and not at school. If you did not eat this food or drink this beverage during the past week, please mark "never or less than 1 per week."

This first section is about beverages (or drinks).

Type of drink 	Location	How often did you drink these beverages in the past week? (mark one in each row)						
		Never or less than 1 per **week**	1 per **week**	2-4 per **week**	5-6 per **week**	1 per **day**	2-3 per **day**	4+ per **day**
Q.1 Orange juice, apple juice and other 100% juices	At School	○	○	○	○	○	○	○
	Not at School	○	○	○	○	○	○	○
Q.2 Fruit drinks (such as Snapple, flavored teas, Capri Sun and Kool-Aid)	At School	○	○	○	○	○	○	○
	Not at School	○	○	○	○	○	○	○
Q.3 Sport drinks (such as Gatorade or PowerAde); these drinks usually **do not** have caffeine	At School	○	○	○	○	○	○	○
	Not at School	○	○	○	○	○	○	○
Q.4 Flavored waters such as Propel or vitamin waters; these drinks usually **do not** have caffeine	At School	○	○	○	○	○	○	○
	Not at School	○	○	○	○	○	○	○
Q.5 Unflavored bottled water, tap water, water from a drinking fountain, or other unflavored water	At School	○	○	○	○	○	○	○
	Not at School	○	○	○	○	○	○	○
Q.6 Diet soda or pop (include all kinds such as Diet Pepsi, Pepsi One, Diet Coke, Diet 7-Up)	At School	○	○	○	○	○	○	○
	Not at School	○	○	○	○	○	○	○
Q.7 Regular soda or pop (include all kinds such as Coke, Pepsi, 7-Up, Sprite, root beer)	At School	○	○	○	○	○	○	○
	Not at School	○	○	○	○	○	○	○
Q.8 Energy drinks (such as Rockstar, Red Bull, Monster and Full Throttle); these drinks usually have caffeine	At School	○	○	○	○	○	○	○
	Not at School	○	○	○	○	○	○	○
Q.9 Sweetened coffee or tea drinks like a Frappuccino, Frappe, or Chai (**do not** include unsweetened coffee or tea)	At School	○	○	○	○	○	○	○
	Not at School	○	○	○	○	○	○	○
Q.10 1% or nonfat **flavored** milk (sometimes called skim, fat-free, or low-fat milk; includes chocolate and other flavors but **not** unflavored, white milk)	At School	○	○	○	○	○	○	○
	Not at School	○	○	○	○	○	○	○
Q.11 Regular or 2% **flavored** milk (sometimes called whole, reduced fat, or 4% milk fat; includes chocolate and other flavors but **not** unflavored, white milk)	At School	○	○	○	○	○	○	○
	Not at School	○	○	○	○	○	○	○
Q.12 1% or nonfat white milk (sometimes called skim, fat-free, or low-fat milk; **do not** include chocolate or other flavored milks)	At School	○	○	○	○	○	○	○
	Not at School	○	○	○	○	○	○	○
Q.13 Regular or 2% white milk (sometimes called whole, reduced fat, or 4% milk fat; **do not** include chocolate or other flavored milks)	At School	○	○	○	○	○	○	○
	Not at School	○	○	○	○	○	○	○

This next section is about foods.

Type of food 	Location	How often did you eat these foods in the past week? (mark one in each row)						
		Never or less than 1 per week	1 per week	2-4 per week	5-6 per week	1 per day	2-3 per day	4+ per day
Q.14 Low-fat or non-fat potato chips, tortilla chips and corn chips (such as Baked Lays, Reduced-fat Doritos, Fat-Free Pringles)	At School	○	○	○	○	○	○	○
	Not at School	○	○	○	○	○	○	○
Q.15 Regular potato chips, tortilla chips, corn chips and puffs (such as all flavors of Ruffles, Lay's, Pringles, Doritos, Fritos, Cheetos)	At School	○	○	○	○	○	○	○
	Not at School	○	○	○	○	○	○	○
Q.16 Other salty snacks (like cheese nibs, Chex mix, gold fish crackers, Ritz Bitz)	At School	○	○	○	○	○	○	○
	Not at School	○	○	○	○	○	○	○
Q.17 Candy, including chocolate, candy bars, jelly bellies, gummies and Lifesavers (**do not** include cookies)	At School	○	○	○	○	○	○	○
	Not at School	○	○	○	○	○	○	○
Q.18 Doughnuts, pop tarts or other breakfast pastries	At School	○	○	○	○	○	○	○
	Not at School	○	○	○	○	○	○	○
Q.19 Cookies, brownies, pies and cakes	At School	○	○	○	○	○	○	○
	Not at School	○	○	○	○	○	○	○
Q.20 Low or nonfat frozen desserts such as low fat ice cream, frozen yogurt, popsicles, & sherbet	At School	○	○	○	○	○	○	○
	Not at School	○	○	○	○	○	○	○
Q.21 Regular ice cream & milkshakes (include all flavors)	At School	○	○	○	○	○	○	○
	Not at School	○	○	○	○	○	○	○
Q.22 How often did you eat a serving of vegetables such as green salad, peas, green beans or corn? (**do not** count fried potatoes or French fries)	At School	○	○	○	○	○	○	○
	Not at School	○	○	○	○	○	○	○
Q.23 How often did you eat a serving of fruit such as a banana, apple or grapes? (**do not** count juices)	At School	○	○	○	○	○	○	○
	Not at School	○	○	○	○	○	○	○

This is the end, Thank You!

Adapted from the PLAN Project Food Questionnaire

Appendix E: Audit Instrument

A la carte Inventory

School:

_____

Evaluator:

_____

Date, Day:

Water availability

- ☐ Water fountain
- ☐ Water cooler with/without cups (circle)
- ☐ Water bottles
- ☐ Water tap
- ☐ Other:_____

Beverages

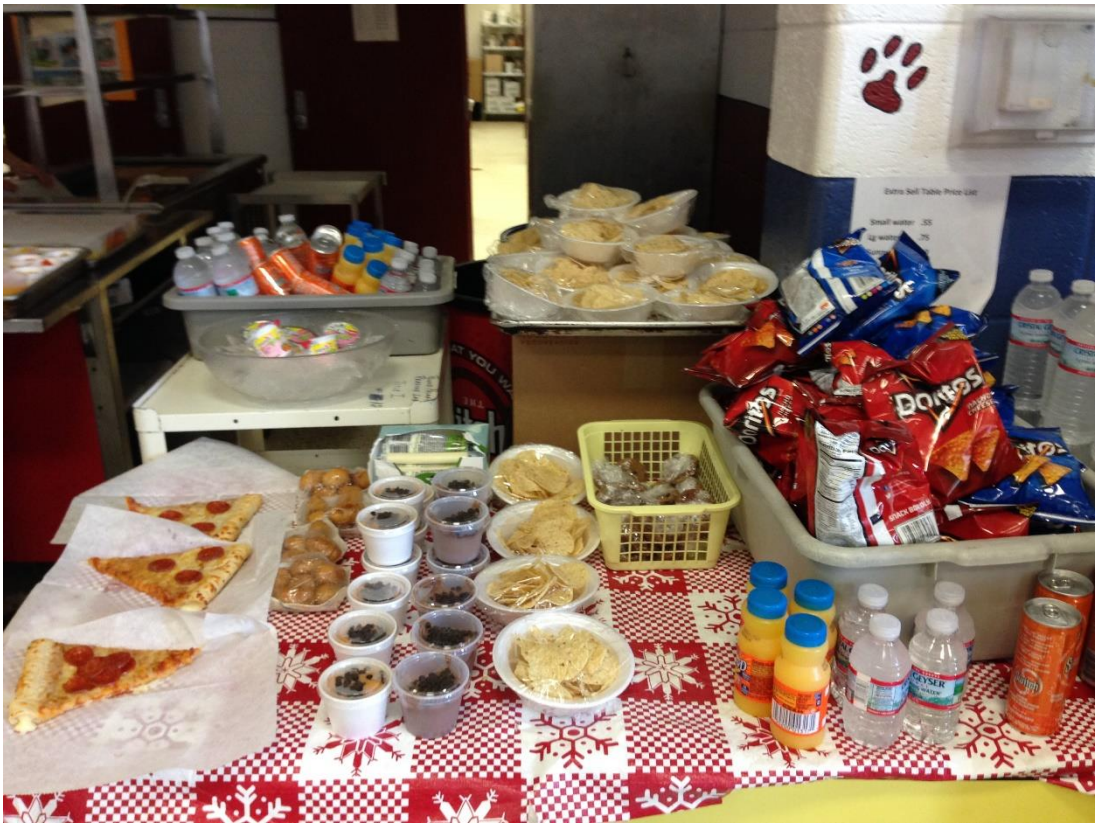
Brand *Coke, Pepsi*	**Item** *Coke, Diet Coke, Sprite*	**Size (oz)**	**Price ($.$$)**	**Days available**	**Notes**

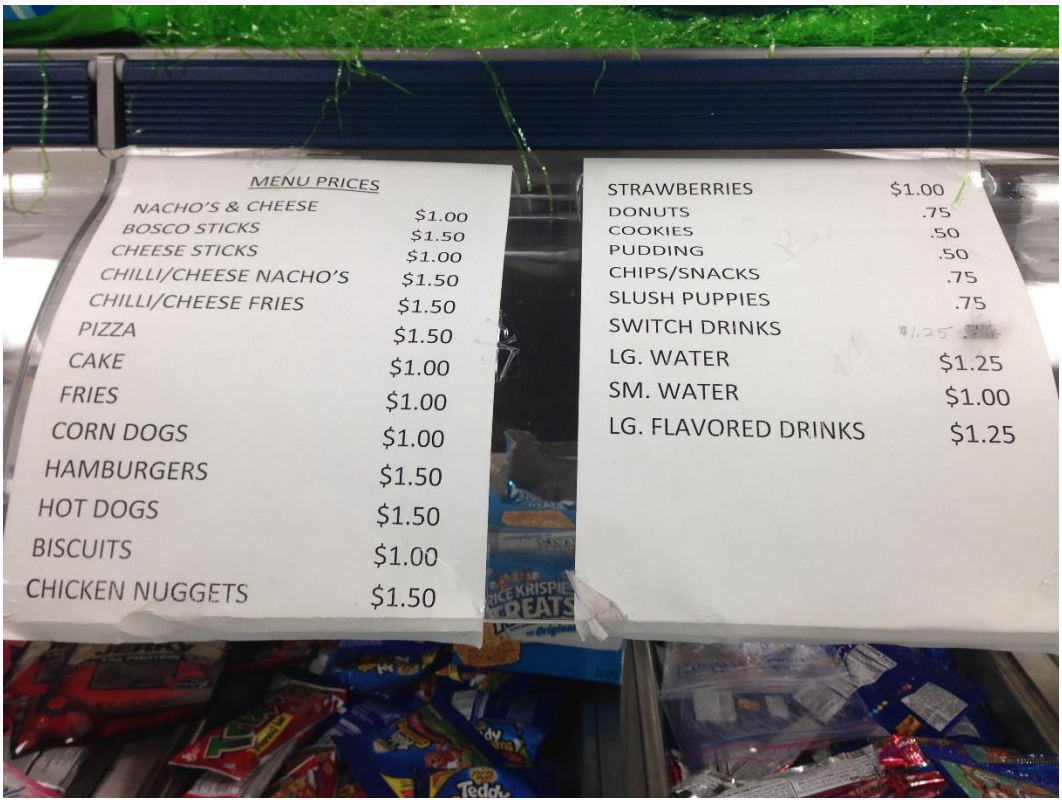
A la carte Inventory

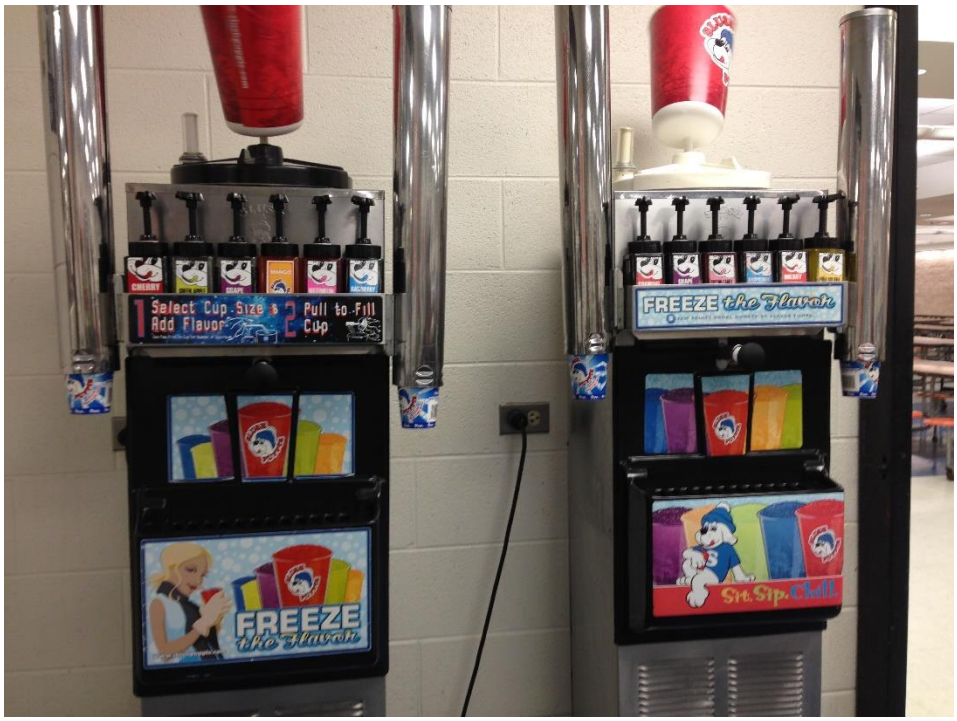
Brand *Nature Valley, Snyder's, Welch's*	Item *Oat and Honey bar, fruit snacks*	Description *Pretzels, granola bar, fruit snacks*	Size (grams)	Price ($.$$)	Days available	Notes

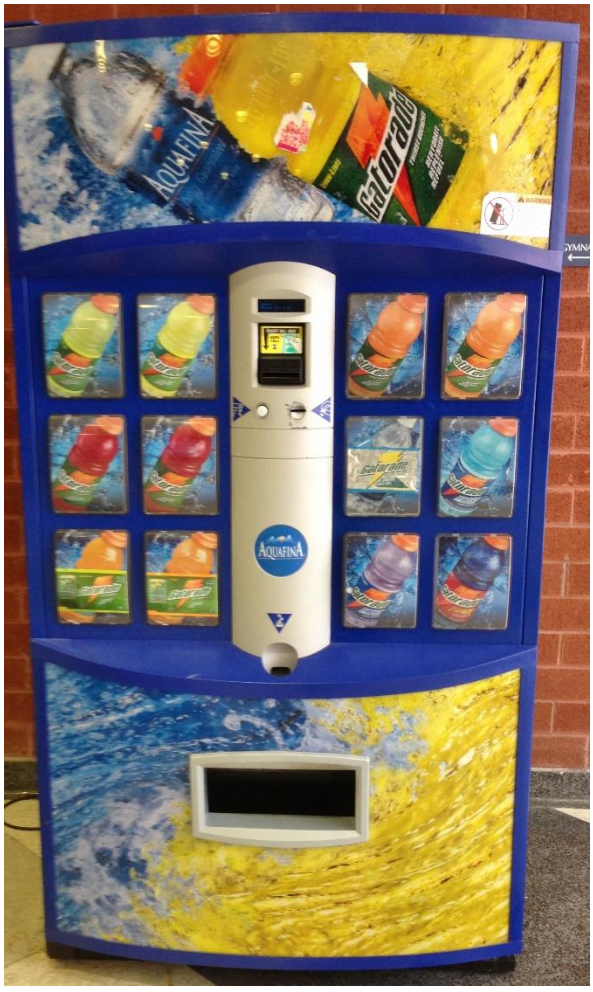
Other notes/observations:

Appendix F: Baseline Photographs

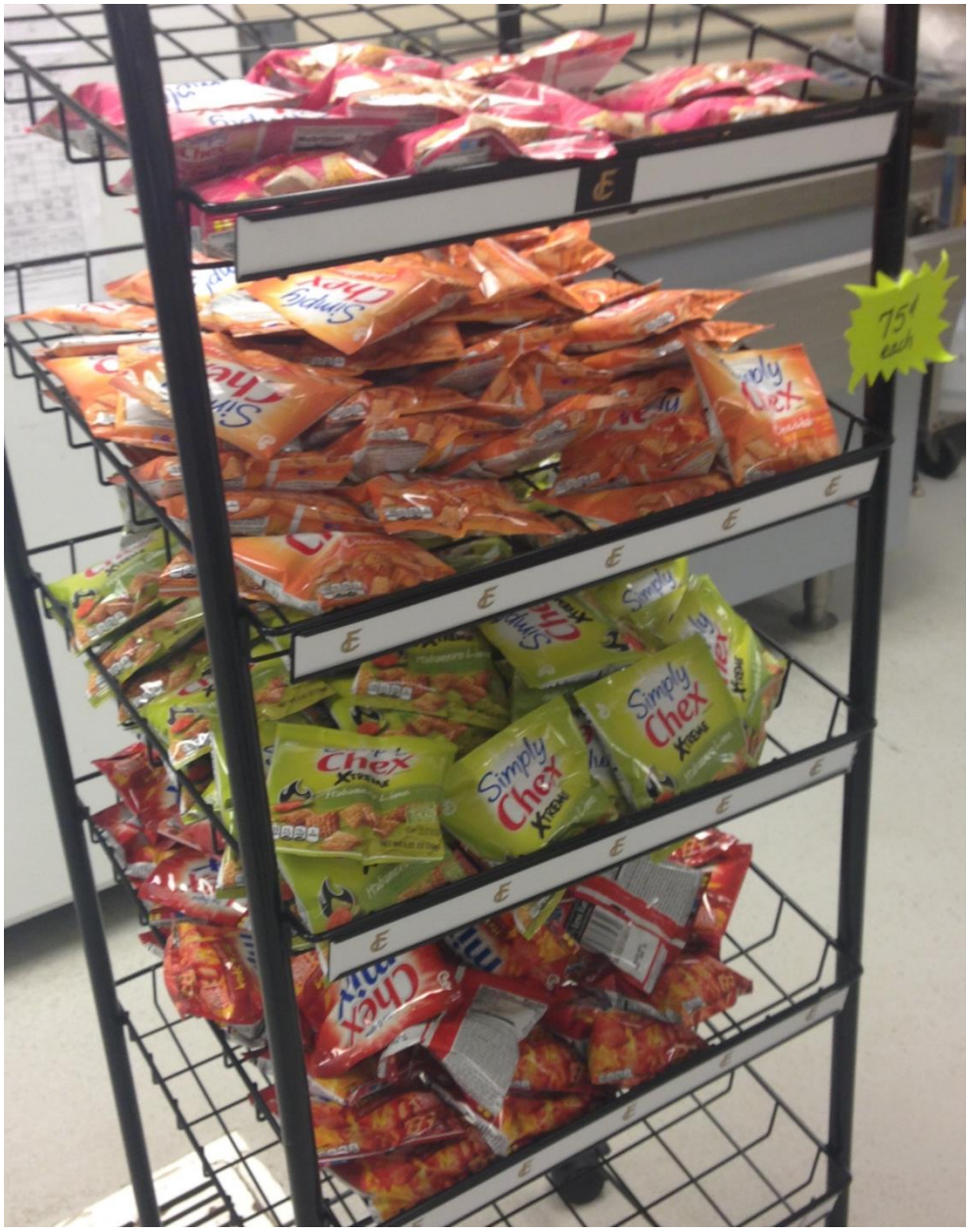


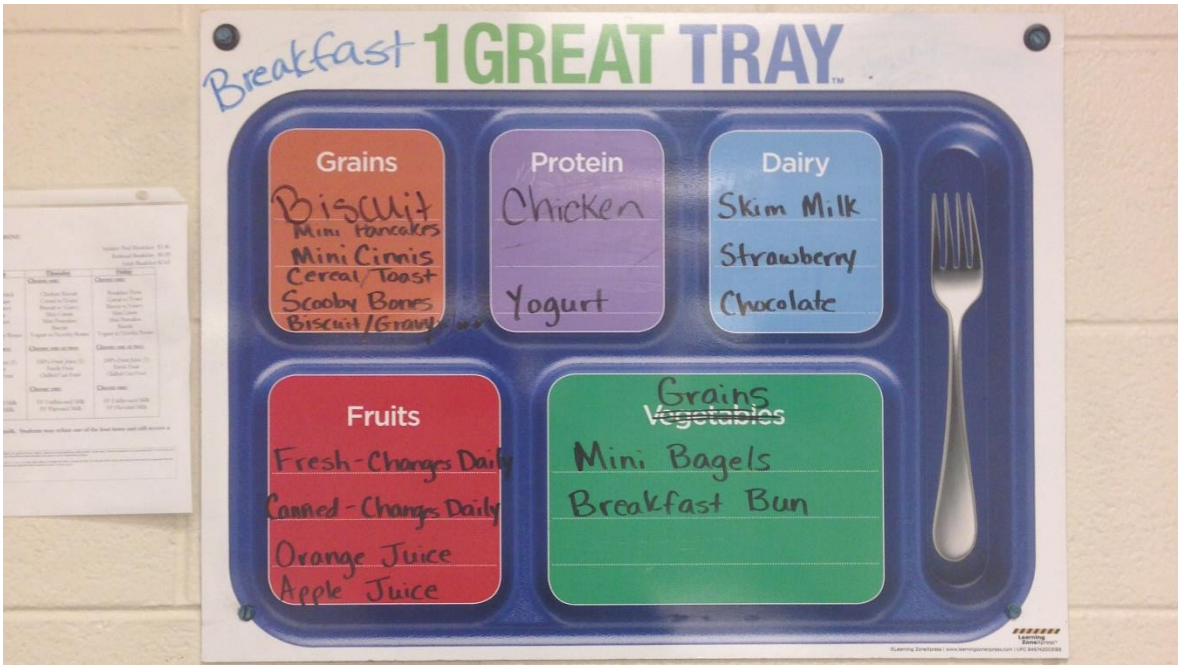



Select Cup Size &
Add Flavor
Pull to Fill
Cup
FREEZE the Flavor
FREEZE the Flavor
Sit. Sip. Chill.


AQUAFINA
AQUAFINA

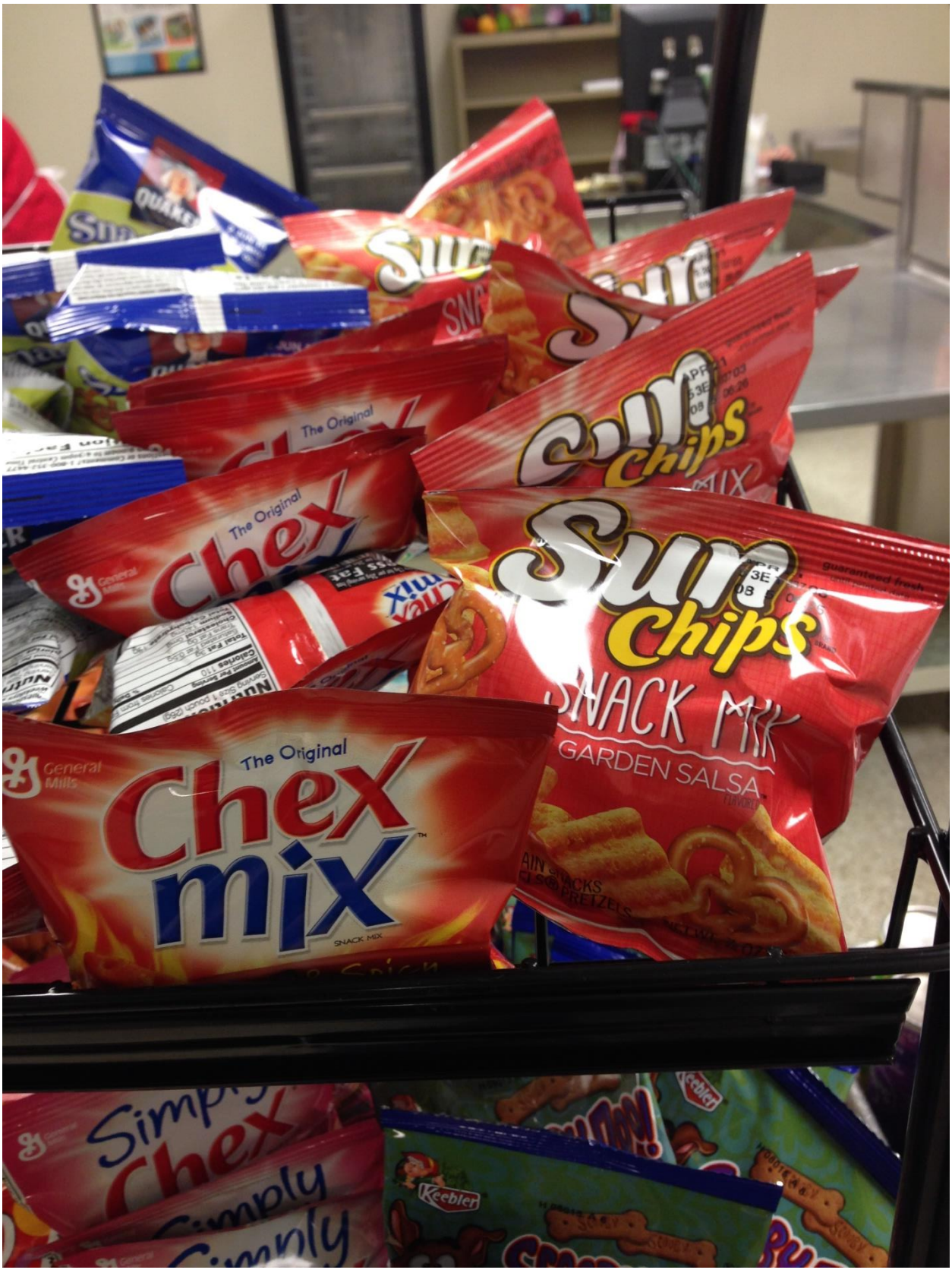
Appendix G: Post-Implementation Photographs

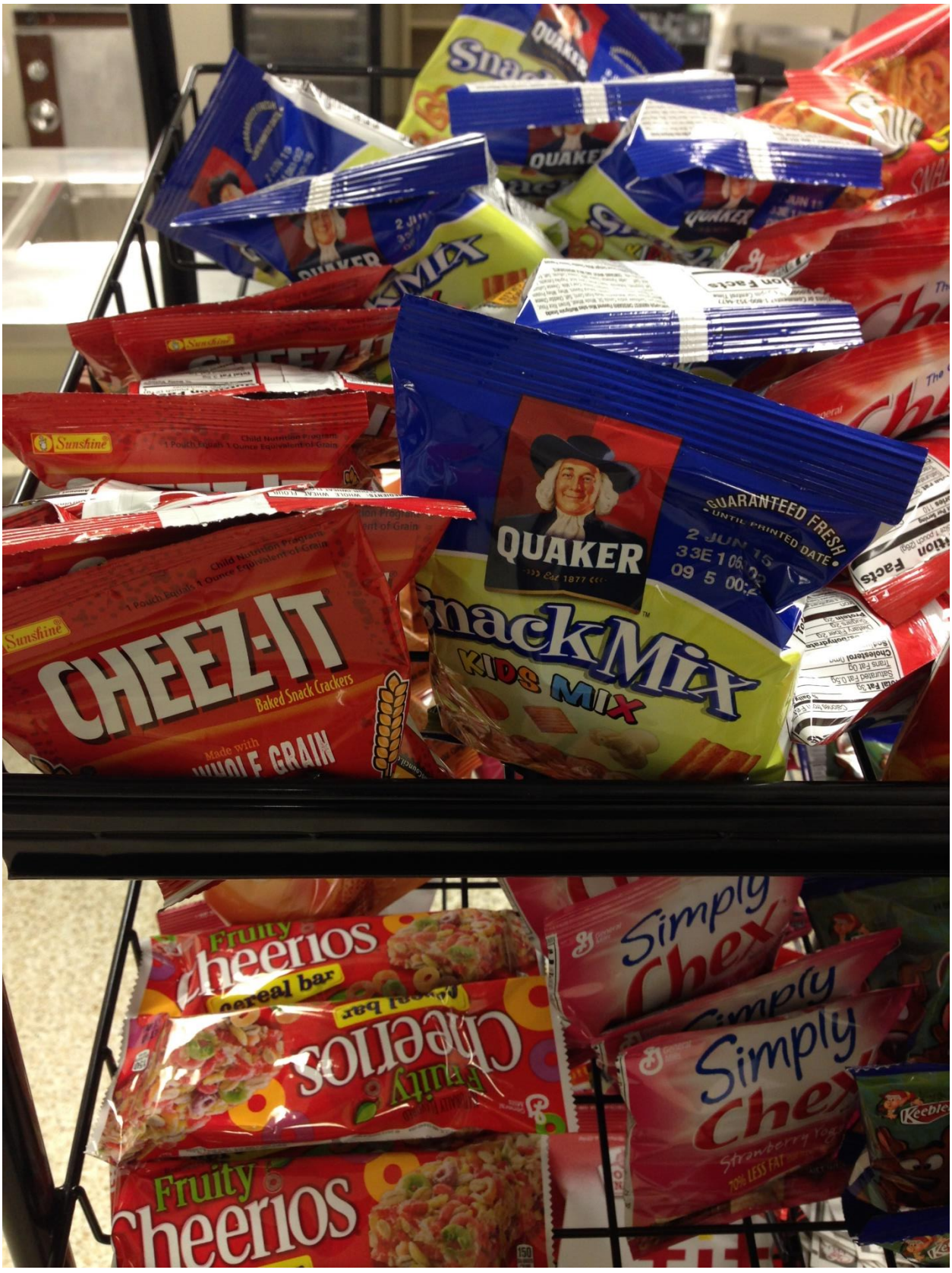


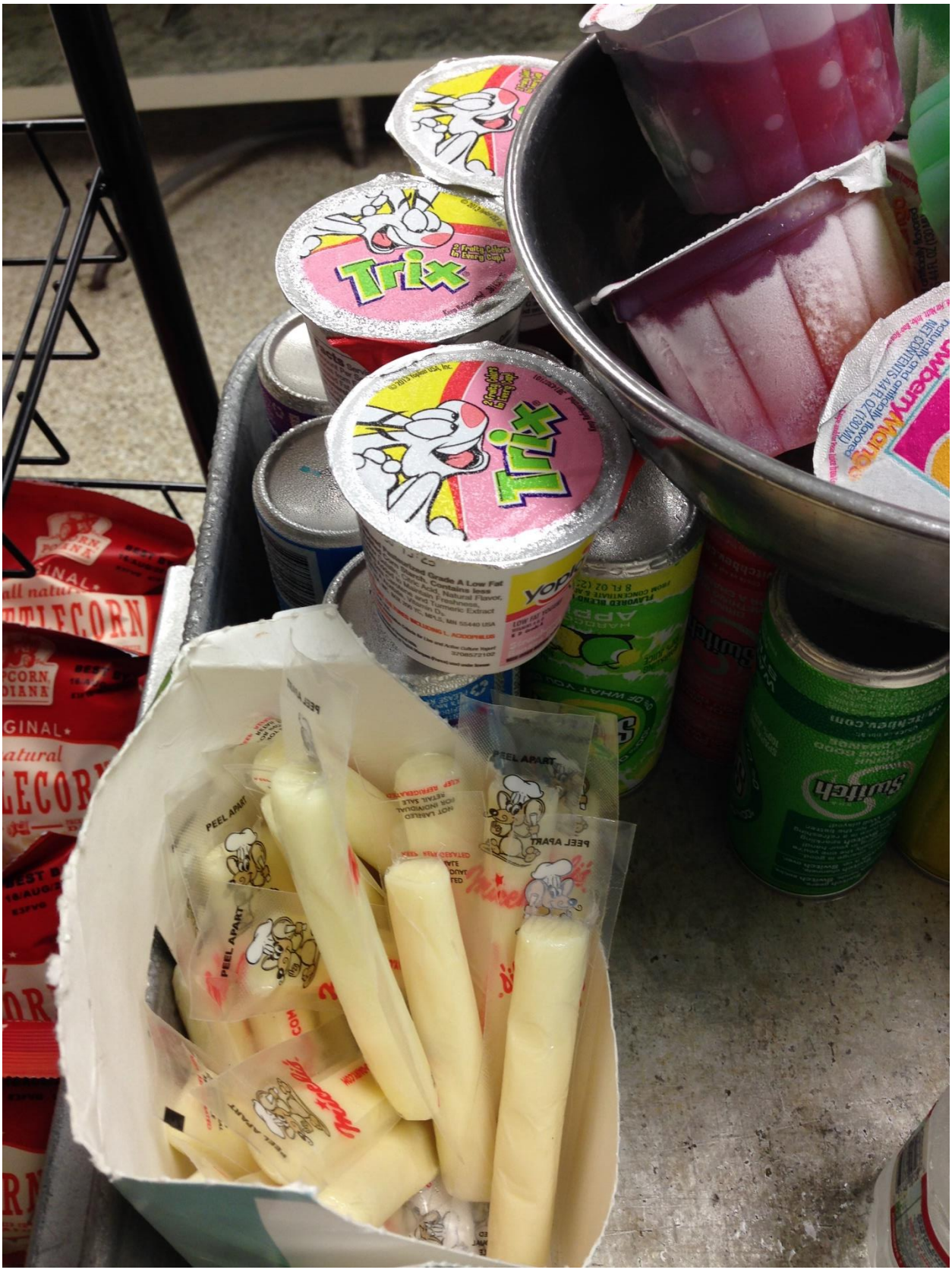


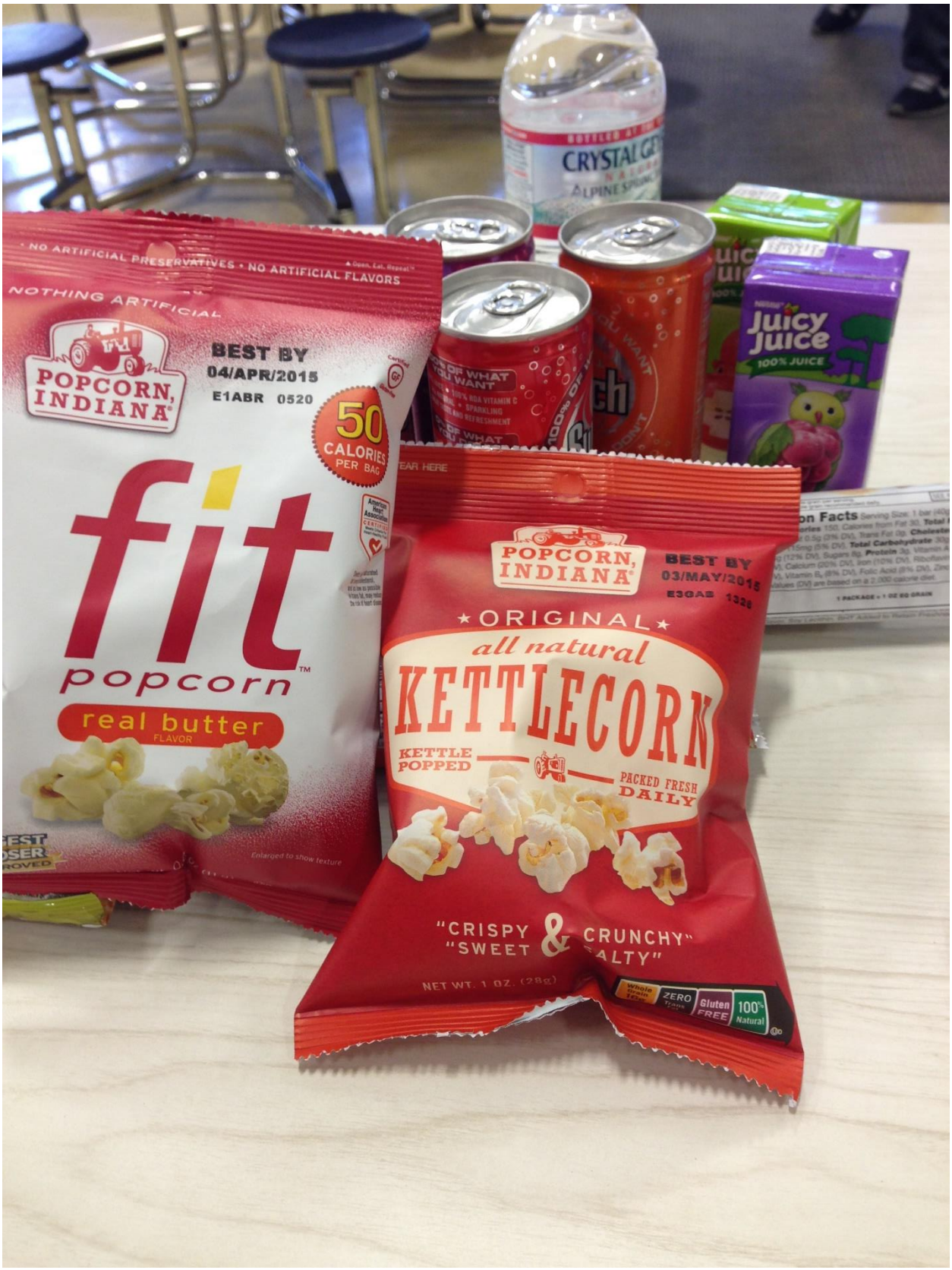
A LA CARTE PRICES

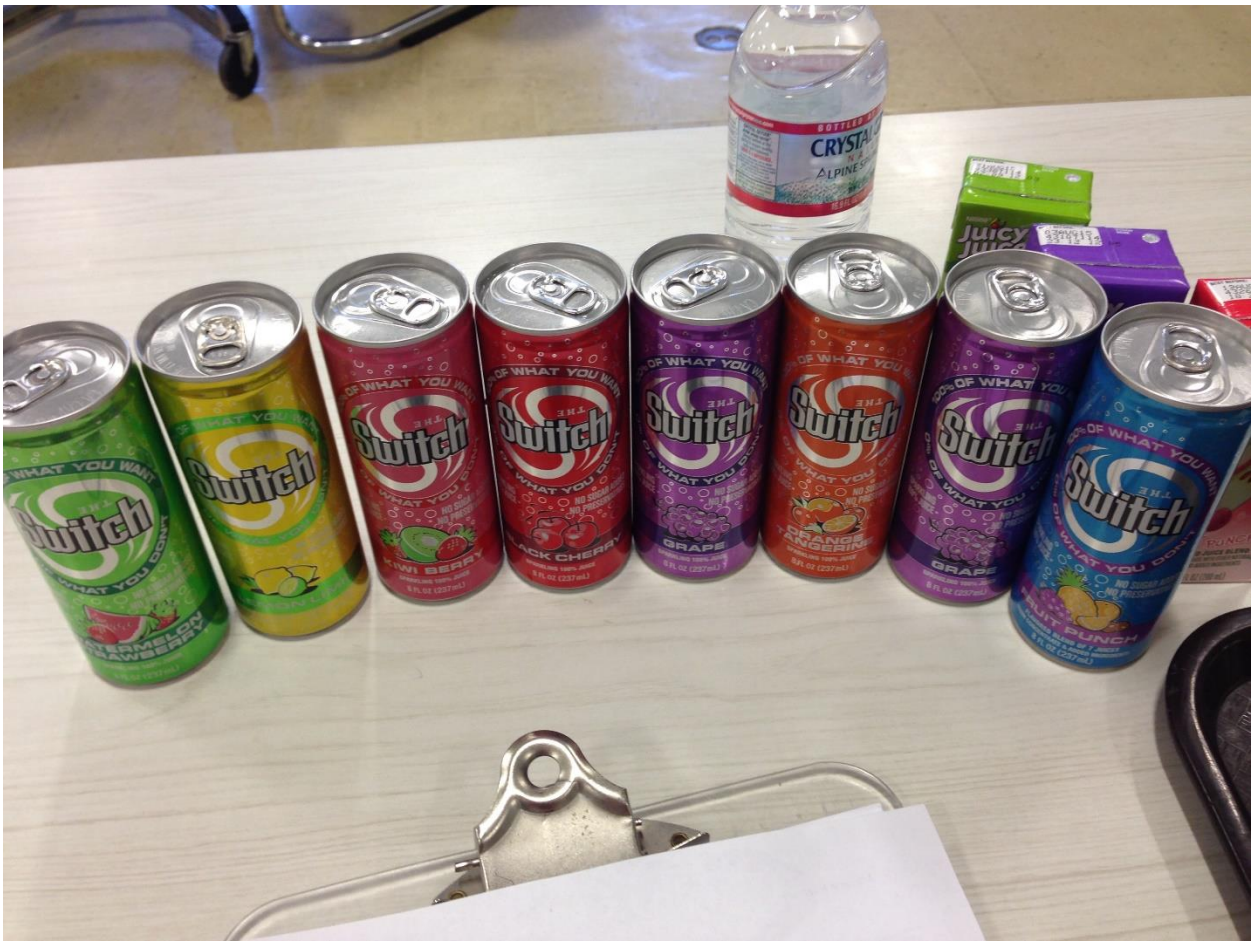
Entrée (Main Dish)	Elem. $1.50 Mid/Hi 1.50	Fruits or Vegetables	.75
Hamburger Patty	.85	Raisins	.60
Biscuit, Roll	.50	Yogurt (4 oz)	.75
Biscuit with Chicken, Gravy or Sausage	.85	Tossed Salad (Small) Tossed Salad (Large)	1.75 2.50
Jumbo Waffles (2)	.50	Toast (Slice)	.30
Cereal Bowl	.60	Lay's Baked Potato Chips	1.10
Pancake on a Stick	1.00	Pop Tarts (2)	.80
Honey 9 g/Tartar Sauce 12 g (1)	.20	WW Saltines (2 ct.)	.10
Condiments/Taco Sauce (2)	.10	Cookie	.25
French/Ranch (FF) Dressing 12 g (2)	.30	Cereal Bars (Kellogg's)	.80
Sausage Patty	.50	Milk	.55
Cinnamon Bun	1.00	Switch, Juice 8 oz.	1.25
Mini Cinn.; Blueberry or Maple Waffle (Packet)	1.00	Tomato Juice 5.5 oz Fruit Juice (4 oz)	.90 .35
Zoo Animal Crackers – Graham Crackers (3 ct.)	.30	Water (Small) Water (Large)	.75 1.50
Teddy Grahams, Fruit Roll-Up, Munchies	.75	Coke Product 100% Juice (10 oz. bottle) Juicy Juice (6.75 oz.)	1.00 .75

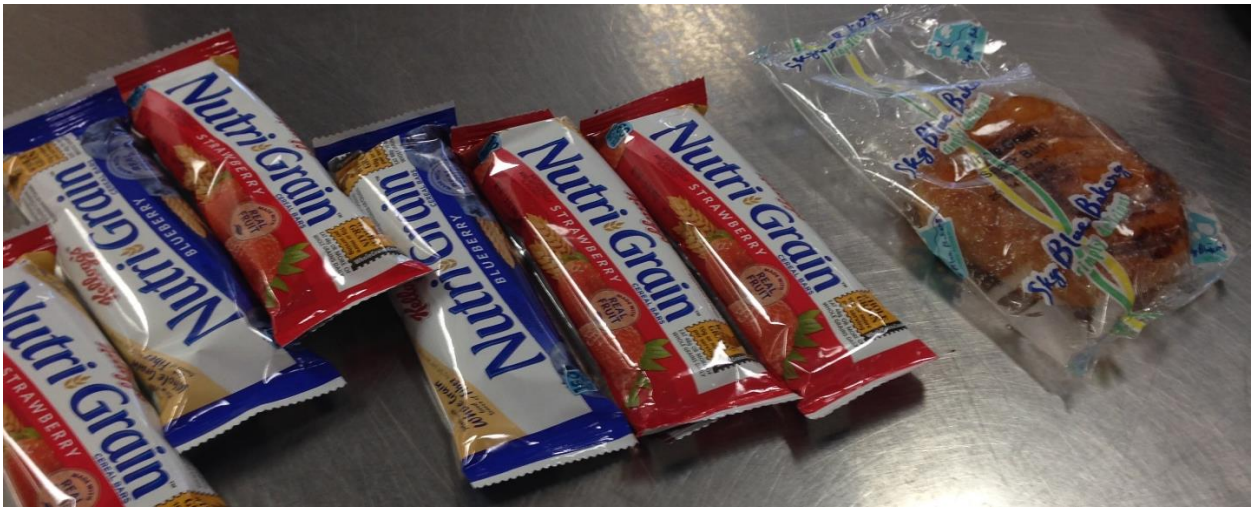

The Original
Chex
mix
SNACK MIX
Sun Chips
SNACK MIX
GARDEN SALSA
Keebler

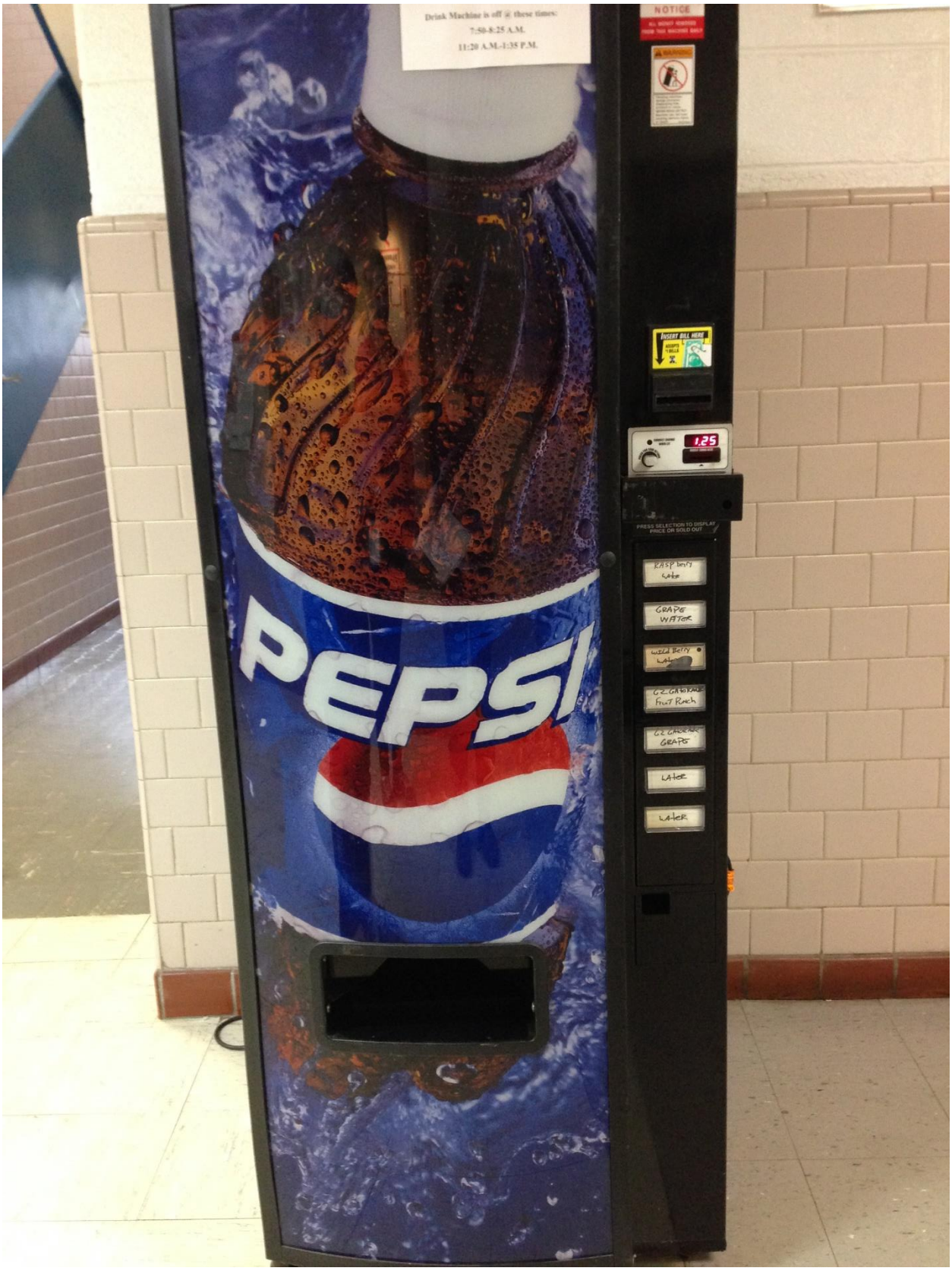

QUAKER
CHEEZ-IT
Baked Snack Crackers
Sunshine
SnackMix
KIDS MIX
GUARANTEED FRESH
Fruity
cheerios
cereal bar
Simply
Chex

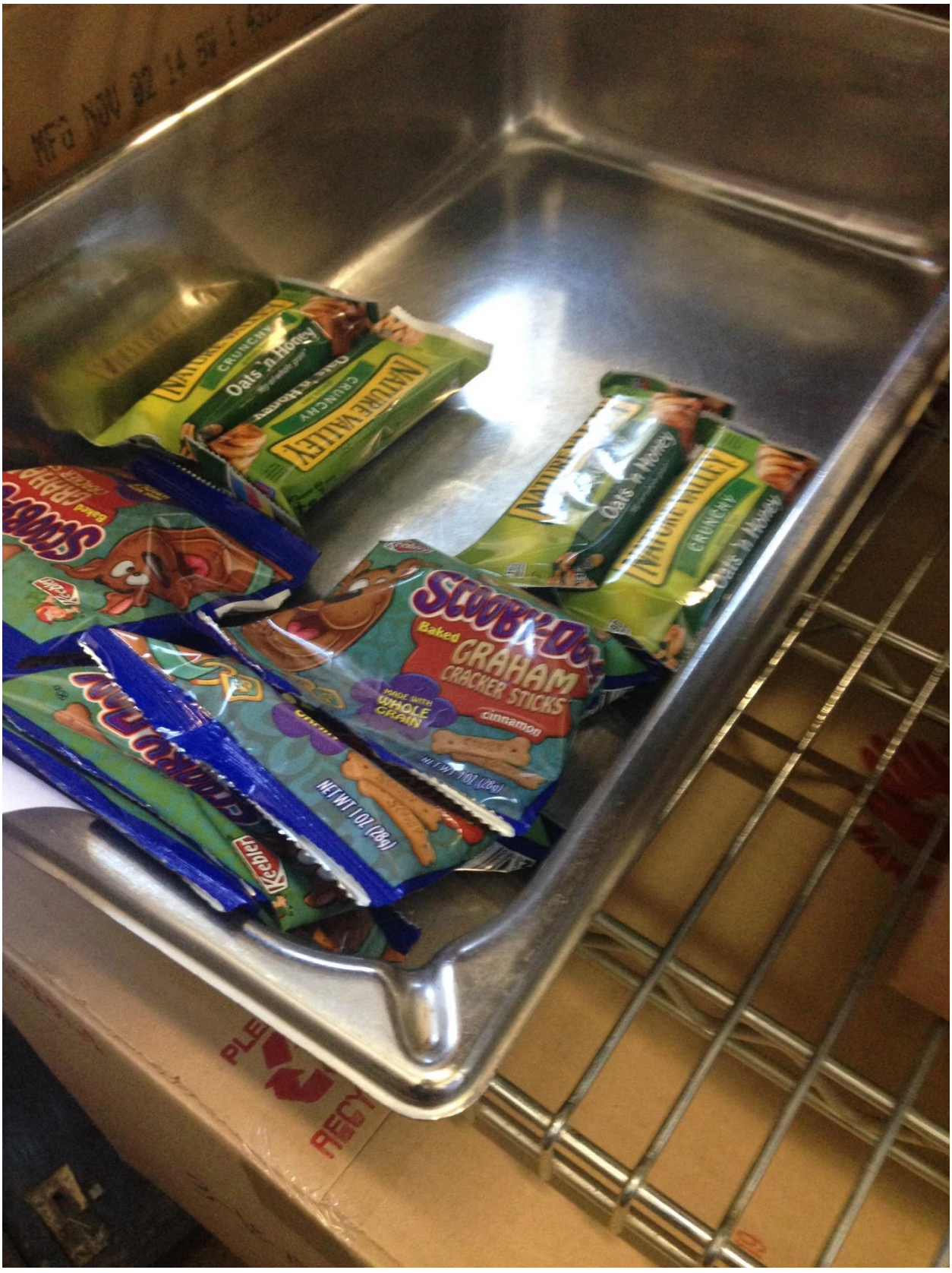

Trix
Trix
PEEL APART
PEEL APART
PEEL APART

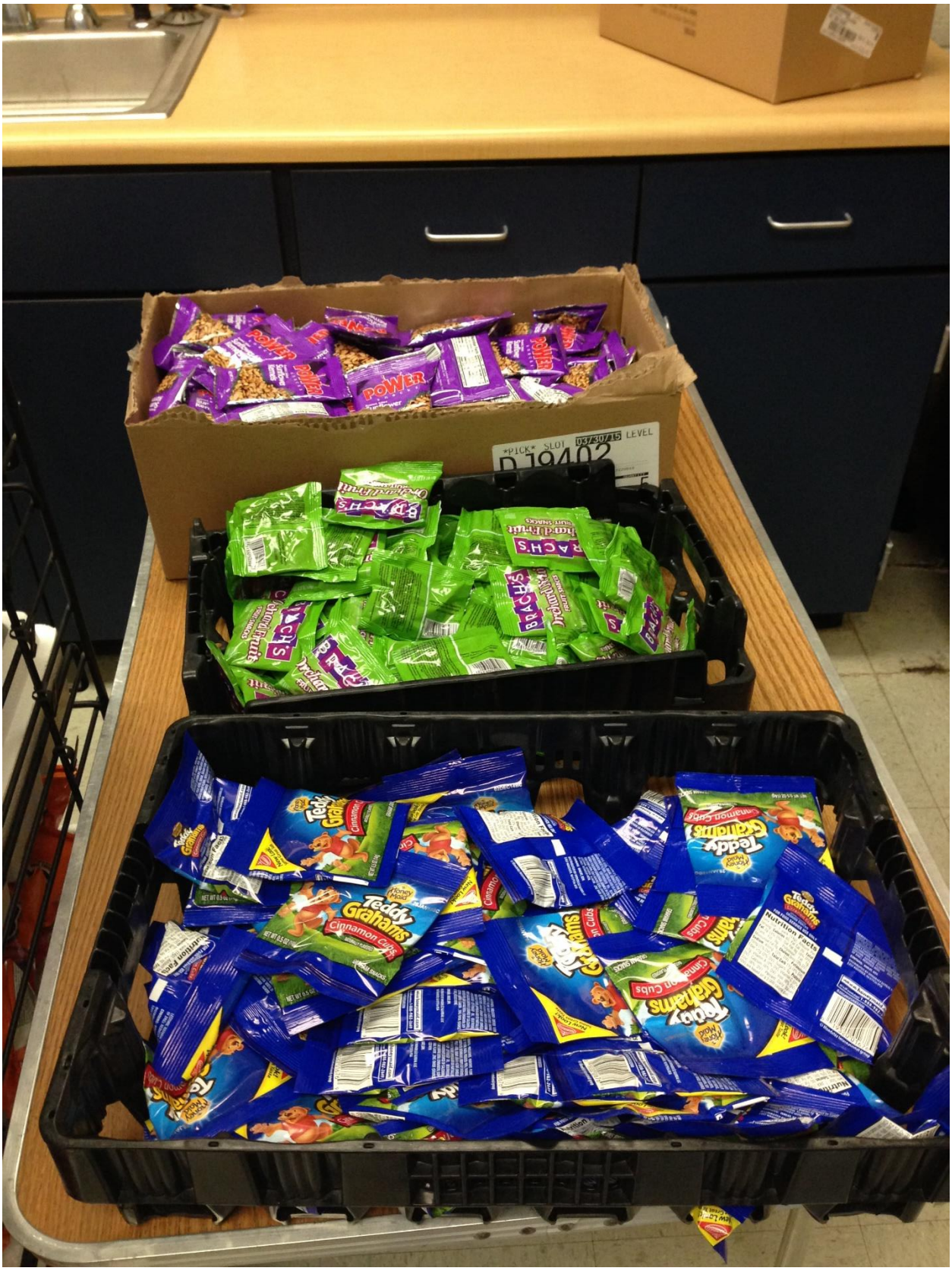

NO ARTIFICIAL PRESERVATIVES • NO ARTIFICIAL FLAVORS
NOTHING ARTIFICIAL
POPCORN, INDIANA
BEST BY
04/APR/2015
E1ABR 0520
50 CALORIES PER BAG
fit
popcorn
real butter
FLAVOR
Juicy Juice
100% JUICE
POPCORN, INDIANA
BEST BY
03/MAY/2015
ORIGINAL
all natural
KETTLECORN
KETTLE POPPED
PACKED FRESH DAILY
"CRISPY & CRUNCHY"
"SWEET
NET WT. 1 OZ. (28g)
ZERO
Gluten FREE
100% Natural

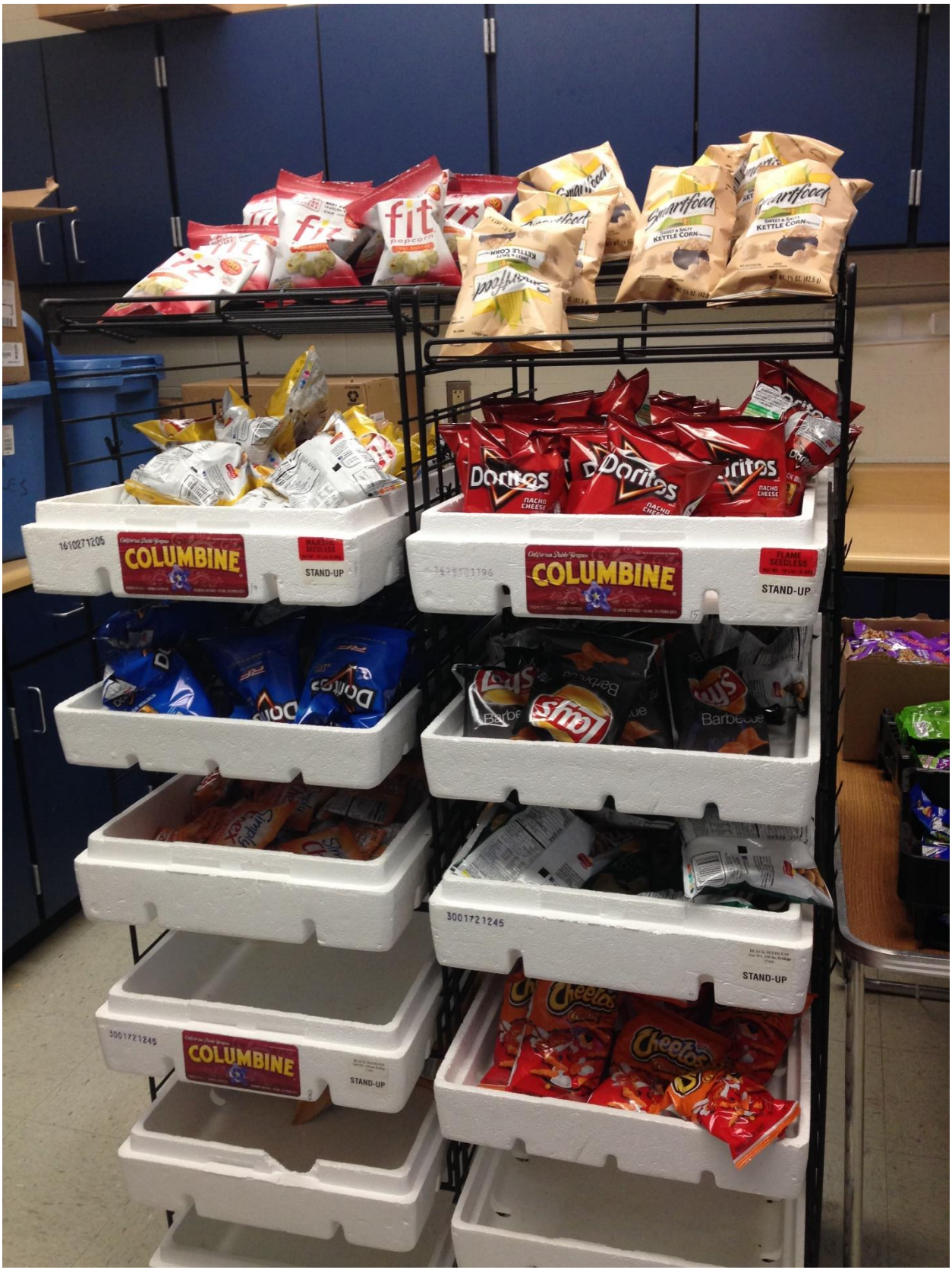

Switch
GRAPE
FRUIT PUNCH

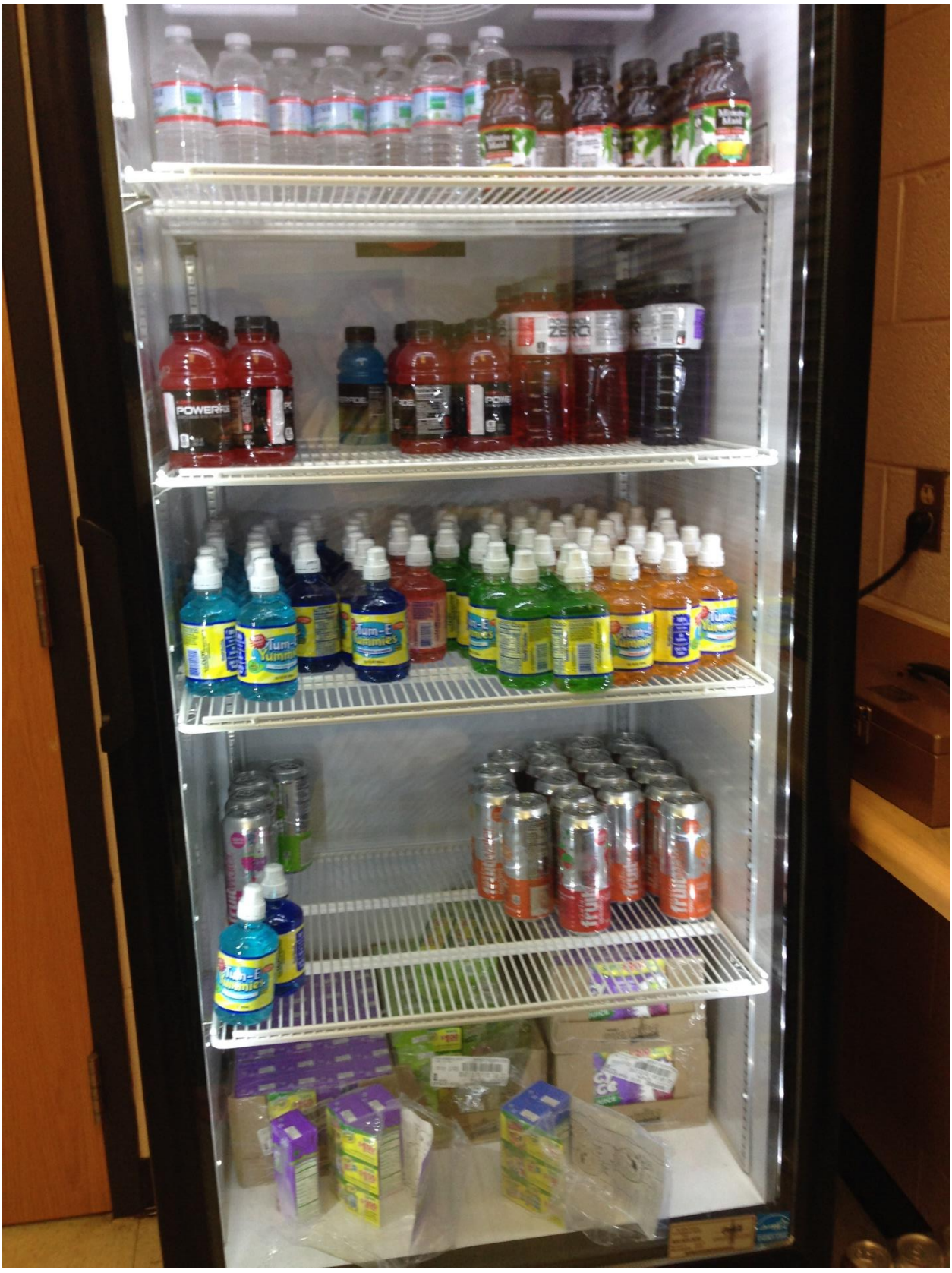

Nutri Grain
STRAWBERRY
BLUEBERRY
Sky Blue Bakery


Drink Machine is off @ these times:
7:50-8:25 A.M.
11:20 A.M.-1:35 P.M.
NOTICE
INSERT BILL HERE
1.25
PRESS SELECTION TO DISPLAY PRICE OR SOLD OUT
PEPSI


NATURE VALLEY
CRUNCHY
Oats 'n Honey
Baked
GRAHAM
CRACKER STICKS
cinnamon
MADE WITH WHOLE GRAIN
NET WT 1 OZ (28g)
Keebler


POWER
BRACH'S
Teddy Grahams
Cinnamon Cubs


fit
popcorn
Smartfood
SWEET & SALTY
KETTLE CORN
Doritos
NACHO CHEESE
COLUMBINE
STAND-UP
Cheetos
3001721245


POWERR
ZERO
Yum-E
Yummies