ABSTRACT

The Healthy, Hunger-Free Kids Act of 2010 challenged school districts to modify their existing lunch menus to better meet the Dietary Guidelines for Americans. Though National School Lunch Program nutrition standards have improved, overall dietary quality remains variable. Chef-led culinary and nutrition interventions have emerged across the United States to help schools meet these recommendations and improve dietary quality and appeal of school lunches. The Oklahoma culinary training program aimed at these objectives, plus individualized mentorship, menu development, and techniques to enhance to the foodservice environment, is Cooking for Kids. The present study assesses dietary quality of school lunches served at Middleburg Public School prior to their participation in the Cooking for Kids program. Nutrient analysis and the Healthy Eating Index were used to quantify dietary quality. This calculated value, 65.8 ± 13.8, was compared to a Typical School Menu meeting baseline National School Lunch Program standards and a Best Practice School Menu optimizing nutrition. Results indicated similarities in dietary quality between the Typical Menu and the Middleburg Menu (75.1 ± 5.8, $p = 0.211$) but a significant difference in dietary quality between the Best Practiced Menu and the Middleburg Menu (91.8 ± 5.1, $p = 0.012$). Reasons for this contrast include differences in sodium, fiber, vegetable and fruit diversity, and whole grain meal components. These findings helped develop dietary recommendations for Middleburg Public School as they begin their participation in Cooking for Kids. For, a higher dietary quality is positively correlated with better academic performance and cognitive development amongst school children, and a reduction in the likelihood of developing chronic disease in the future.

COOKING FOR KIDS: DIETARY QUALITY OF MIDDLEBURG PUBLIC SCHOOL LUNCHES

A Baseline Assessment of Middleburg Public School Dietary Quality Compared to that of a Typical Menu and a Best Practice Menu after Implementation of National School Lunch Program Guidelines

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INTRODUCTION

School lunches have grown to be a valuable part of the total education program; they nourish students' health, growth, and cognitive development (Food Research & Action Center, 2018). The National School Lunch Program is the federally assisted meal program operating in both public and non-profit private schools, which provides nutritionally balanced meals to students each school day (United States Department of Agriculture, 2017). The Food and Nutrition Service of the United States Department of Agriculture administers the National School Lunch Program, establishes its federal guidelines, and regularly updates its nutrition requirements. In 2010, the United States Department of Agriculture implemented the Healthy, Hunger-Free Kids Act, improving nutrition standards provided by school meal patterns and increasing access to healthy food for low-income children (United States Department of Agriculture Food and Nutrition Services, 2017). The updated regulations ensure students are offered both fruits and vegetables every day of the week, increase the availability of whole grain-rich foods, offer fat-free or low-fat milk varieties, set calorie ranges and portion sizes, and focus on the reduction of saturated fats and sodium-dense foods (United States Department of Agriculture Office of Communications, 2017). Though positive recommendations, schools face increased financial burdens adhering to the Healthy, Hunger-Free Kids Act regulations alongside a decline in school lunch participation (American Society of Nutrition, 2017). Therefore, statewide, culinary programs have emerged to assist schools in the implementation of these standards while enhancing the meal service experience for students; one of which is Cooking for Kids.

Cooking for Kids is a culinary training program for school nutrition professionals developed by the Oklahoma State University Department of Nutritional Sciences with funding provided by the Oklahoma State Department of Education. Cooking for Kids aims to change the landscape of school nutrition through greater availability of freshly prepared foods, increased student participation in school meals, and the expansion of public support for child nutrition programs (Cooking for Kids, 2018). It provides schools with workforce development, chef consultations, and resources needed to move from processed foods toward scratch preparation and increased fruit and vegetable usage and availability, while offering foods children need and want to eat (Till et al., 2017).

The program has brought forth several positive outcomes. School nutrition professionals who participate in the Cooking for Kids program demonstrate an increase in nutrition knowledge, knife skills, use of standardized recipes, time management, food safety, and professionalism (Blevins et al., 2016). Also, they learn how to successfully prepare and offer wholesome school meals which increase student consumption of healthier foods (Till et al. 2017). Meal component consumption analyses from prior evaluations indicate that schools who use less convenience foods for entrees and offer more salad bars, have no negative impact on entrée consumption and increase the consumption and selection of grain and fruit meal components (Powell, et al. 2017). However, though students appear to be consuming more of the fruit, vegetable, and grain meal components, an analysis of the dietary quality of meals offered by schools after participation in the chef consultation phase of the program is still needed.

The purpose of the current study is to evaluate dietary quality of school lunches served at Middleburg Public School prior to implementation of Cooking for Kids within its foodservice environment and to determine if there is a significant difference in nutrient content between a week of Middleburg's school meals, Typical school meals, and Best Practice school meals. Values of particular interest were nutrients required by the National School Lunch Program, major nutrients not required by the National School Lunch Program but of dietary significance, and Healthy Eating Index scores for overall dietary quality. This study reviews benefits of optimizing dietary quality in school lunches, provides guidance for improving school lunch offerings, and offers nutrition recommendations that can be utilized by the Cooking for Kids program during chef-led culinary training sessions and consultations.

LITERATURE REVIEW

I. Current School Lunches

School lunches have rapidly evolved over the past century, progressing from an idea to a commonplace in the education system. Serving standardized lunches to children started with private organizations who were interested in child welfare. School lunches were not a nationwide policy, but a practice in individual cities and states until it acquired acceptance. At the turn of the twentieth century, concern for child malnutrition inspired philanthropic groups to provide balanced meals to students during the lunch hour (Avey, 2015). Unfortunately, without legislation guaranteeing the success of school lunches in years to follow, local school boards were reluctant to take on the extensive program. However, in 1946, recognizing the significance of the school lunch program and its benefits towards the prevention of child malnutrition and its role in national defense, President Truman signed the National School Lunch Act. It states, "as a measure of national security, to safeguard the health of the nation's children and to encourage the domestic consumption of agricultural foods, assistance is provided to the States through federal meal grants; this aid adequately supplies educational facilities and establishments with food for the maintenance and national expansion of non-profit school lunch programs" (Richard B. Russell National School Lunch Act, 1946). As the School Lunch Program spread across the country in the 1950s, it developed avenues by which to serve the country's students more efficiently.

The United States Department of Agriculture continues to fund the National School Lunch Program to ensure that healthful lunches are made affordable and available to all students. Additionally, they establish regulations regarding which foods schools can serve to

students. The standards have evolved over time to better reflect national nutrition recommendations, beginning with the Dietary Guidelines of 1995; this revision addressed public concern and effort to prevent childhood obesity and improve eating habits. In 2008, the Institute of Medicine reported that children who ate school lunches consumed fewer fruits and vegetables and larger amounts of saturated fats and sodium than prescribed by the United States Department of Agriculture; this state of affairs prompted further revisions to the program (Johnson, 2018). With the 2010 Healthy, Hunger-Free Kids Act, the United States Department of Agriculture mandated school meals be composed of more fruits and vegetables, whole grains, fewer calories, and less sodium (Johnson, 2018). A final rule in 2012 updated the meal patterns and nutrition standards of the National School Lunch Programs to align with the Dietary Guidelines for Americans (Federal Register, 2012).

Presently, school meals resemble the United States Department of Agriculture's MyPlate, government guidelines for nutritive eating. Schools serve both fruits and vegetables at lunch with each of the five vegetable subgroups – dark green, red/orange, beans and peas, starchy, and other – being served weekly (School Nutrition Association, 2017). Whole grain-rich products, those defined as containing 51 percent whole grains, accompany each meal; however, *School Meal Flexibilities for School Year 2017-2018* extend state agencies' the option of allowing individual school food authorities to include grains that are not whole grain-rich in their weekly school lunch menu, if done so in moderation (Federal Register, 2018). Meals are paired with a lean meat or plant-based alternative, such as eggs, nuts, seeds, or soy (School Nutrition Association, 2017). Saturated fat must be less than 10 percent of total meal calories, and meals cannot contain *trans* fat. Sodium recommendations, flexible targets of the National

School Lunch Program, are <1230mg for K-5th grade, <1360mg for 6-8th grade, and <1420mg for 9-12th grade (United States Department of Agriculture, 2012). One cup of plain or flavored fat-free or low-fat milk is offered with every meal. To help guide portion sizes, lunch meals meet a specific calorie range for each age/grade group: 550-650kcal for K-5th, 600-700kcal for 6-8th, and 750-850kcal for 9-12th (School Nutrition Association, 2017).

These efforts to improve nutrition standards of school lunches have the capacity to impact a large number of students on a daily basis. Ninety-five percent of schools successfully meet the updated meal standards outlined by the Healthy, Hunger-Free Kids Act of 2010 (United States Department of Agriculture Food and Nutrition Service, 2015). Nearly 100,000 schools and institutions serve school lunches to 30 million students each day ("School Meal Trends & Stats," 2018). Over 73.6 percent of those school lunches are free or reduced price, an assistance for students from low-income households. In 2015, an estimated 676,402 Oklahoma students were offered school lunches; 366,677 of those students received a free school lunch and 55,166 a reduced school lunch. This accounts for a total of 62.37% of Oklahoma students receiving food assistance (Oklahoma Department of Education, 2016). Unfortunately, these numbers are only growing vastly larger. Oklahoma is one of few states whose Department of Education does not require all of its schools to offer the National School Lunch Program; additionally, there is insufficient funding for the program (School Meals Legislation and Funding by State, 2016-2017).

For many children, the meals they eat at school are the only meals they get each day. According to an estimate of national data, free or reduced-price lunches reduce food insecurity by at least 3.8% (Food Research & Action Center, 2018). Children, especially the impoverished,

who participate in school meals are less likely to have nutrient inadequacies and are more likely to consume fruits, vegetables, and milk at lunch (Food Research & Action Center, 2018), along with more fiber and fewer empty calories (Ralston et al. 2017). Low-income students who eat both school breakfast and school lunch have significantly better overall diet quality than low-income students who do not eat school meals. Economists estimate the receipt of free or reduced-price school lunches reduces obesity rates by at least 17% and poor health by at least 29% (Benefits of School Lunch, 2018). With all the behavioral, emotional, mental health, and academic problems prevalent amongst children and adolescence struggling with hunger (Benefits of School Lunch, 2018), school lunches help combat these issues by offering nutritionally balanced meals that support health and well-being for all students, alike.

II. Previous and Current Culinary Training Interventions

Schools participating in the National School Lunch Program must abide by federal and state policies that require nutrient-based standards for school meals; their services must provide students with a variety of nutritious foods that promote individual health and fuel academic performance (Anderson, et al. 2017). Schools are required to serve lunches that provide at least one-third of children's dietary recommendations, meet specific macro-nutrient requirements, limit sodium and saturated fat, and include an array of meat/meat alternatives, whole grains, fruits, vegetables, and low-fat dairy products (Bevans et al. 2011; Food Research & Action Center, 2018; American Society for Nutrition, 2017). Overall, the availability of nutritious foods as part of school meals has shown to decrease nutrient inadequacies, improve overall diet quality, and increase children's consumption of whole grains, fruits, vegetables, and

low-fat milk (Food Research & Action Center, 2018). The new school meal nutrition standards are having a gradual, positive impact on student selection and consumption of healthy foods (Food Research & Action Center, 2018). Culinary interventions and nutrition education programs have assisted in the improvement of dietary quality of school lunches, food diversity, healthier food preparation methods, and child receptivity (Muzaffar et al., 2018).

One of the first, most notable culinary intervention programs was the Eat Smart School Nutrition Program conducted in 96 public elementary schools in California, Louisiana, Minnesota, and Texas; it was designed to provide students with appealing meals that were lower in total fat, saturated fat, and sodium, while maintaining recommended calories, essential nutrients, and student participation (Osganian et al., 1996). It targeted the food service staff and administrators through training sessions, educational materials, and support visits to effect positive changes in the nutritional quality of school meals (Osganian et al., 1996). Results indicated a significant reduction in total fat and saturated fat content of school lunches as offered, while maintaining recommended calorie and essential nutrient content (Osganian et al., 1996).

Although schools participating in the National School Lunch Program are required to meet program standards, nutrition advocates recommend innovations be sought to enhance school meal dietary and sensory quality. The Chef Initiative, a 2-year pilot study in Boston middle schools, was designed to increase the availability and consumption of healthier school foods (Cohen et al., 2012). Between 2007 and 2009, a professional chef trained cafeteria staff to prepare school lunches with more whole grains and fresh/frozen fruits and vegetables, and less sugar, salt, and saturated fats (Cohen et al., 2012). Using a plate waste study, food

selection and consumption patterns were monitored. Chef Initiative schools provided healthier lunches than control schools, with the amount of food consumed on the tray remaining the same (Cohen et al., 2012). However, students chose to eat more of the whole grain and vegetable components (Cohen et al., 2012). This study highlighted the potential of chefs collaborating with cafeteria staff to improve the availability and consumption of healthier school meals.

Culinary intervention and nutrition education of foodservice staff has been attempted by school districts across the United States to increase nutritional quality of school meals and potential to reduce the risk of childhood obesity. Synergy between culinary professionals and nutritionists, both working to move school staff from a precontemplation stage to product and skill maintenance, improves dietary quality (Condrasky et al., 2010). Hands-on, culinary nutrition education encourages individual confidence in food preparation methods and increases the efficiency of wholesome meal production. The Cooking with a Chef program, initiated by South Carolina extension educators, partnered chefs and dietitians to provide nutrition education and hands-on culinary lessons to low-income families. Participants demonstrated an increase in kitchen self-efficacy and improvements in basic cooking techniques. The program increased fruit and vegetable availability in the home, frequency of scratch cooking, and the use of fruits and vegetables in meal preparation (Candrasky et al., 2010). When extended into the school setting, the combination of culinary professionals and nutrition educators generated a positive skill set in the school foodservice staff and positive dietary changes for the children eating lunch (Carahen et al., 2013). There was gain in skill and confidence in the cafeteria staff following the session with the chef (Carahen et al., 2013). The

average number of children eating school lunch increased after the chef led sessions (Carahen et al., 2013).

In May 2010, the White House announced a program titled “Chefs Move to Schools,” as part of the First Lady’s *Let’s Move* campaign (Capperiano, 2011). This program pairs chefs with schools to provide nutrition instruction to children and culinary skill sets to food service workers. A pilot study in an upstate New York high school evaluated the feasibility and impact of chefs on school lunch participation and student consumption under new dietary guidelines (Just et al., 2014). The changes made were designed to have no effect on production costs. The chef modified existing school recipes and consulted with food service staff to ensure compliance with National School Lunch Program standards. Student participation increased significantly when the chef prepared components of the meal. Furthermore, consumption of vegetables increased, with salad consumption increasing most (Just et al., 2014). Salad was added when the chef identified it as an attractive pairing with certain foods. This knowledge could be a benefit of chef participation in schools, suggesting the importance of coordinating main entrees with vegetable and fruit sides when planning school menus (Just et al., 2014). However, there is limited evidence to support whether the increase in student participation resulted from appeal to student preference or students selecting the side with the entrée because it was a reimbursable meal.

Instead of focusing specifically on one school and the effects of one chef, South Carolina’s Team Nutrition attempted to increase the knowledge, skills, and capacity of school food service staff through culinary and Smarter Lunchroom training and assistance in approximately 500 school foodservice staff from 27 different counties (Hoy, 2017).

Participating individuals were trained in culinary skills and technical assistance was provided to National School Lunch Program schools with the goal of enhancing the healthfulness and physical attractiveness of the school foodservice environment and increasing student consumption of healthy foods. Plate waste analysis revealed total waste per serving decreased 69%, and the portion of fresh fruits, hot vegetables, and canned fruit on the tray increased by 11% (Hoy, 2017).

Other small, city-led culinary intervention programs have been successful at meeting their objective to improve dietary quality, promote healthy eating practices, and increase positive perceptions of food and eating behaviors. The Cook Shop Program, LA Sprouts Program, Stephanie Alexander Kitchen Garden Program, and Chefs Adopt a School Scheme have notably improved diet quality and healthy eating practices in student participants (Muzaffar et al. 2018). These programs increased fruit and vegetable, whole grain, and fiber intake. Additionally, the programs were successful at improving staff nutrition and culinary knowledge and cooking self-efficacy, behavioral intentions for cooking and eating plant-based foods, and preferences for healthy eating (Muzaffar et al. 2018). Staff participants developed cooking skills and positive cooking attitudes, and students were more willing to try new foods (Muzaffar et al. 2018). Overall, these smaller programs have personally changed and positively enhanced the National School Lunch Program and the food-education environment.

III. Culinary Training Intervention in Oklahoma

Until October 2013, no culinary training programs aimed towards increasing self-efficacy in food service authorities and enhancing school meals to meet national standards and student

appeal existed in Oklahoma. To address this critical need, the Oklahoma State Department of Education Child Nutrition Programs contracted with Oklahoma State University Department of Nutritional Sciences to develop a chef-based culinary training program for school kitchen managers and staff with the vision of changing school nutrition in Oklahoma (Carl, 2015). Cooking for Kids builds basic culinary skills in its participants, integrates wholesome foods into menu patterns, and provides on-site consultations to Oklahoma National School Lunch Program participating school districts. The purpose of the program is to improve dietary quality and student consumption of reimbursable meals that meet meal pattern and standard nutrition requirements of the United States Department of Agriculture.

A baseline study of Cooking for Kids, conducted in Spring 2014, measured student consumption of school meals following revisions to the Healthy, Hunger-Free Kids Act and prior to implementation of the pilot culinary training program; it also evaluated the differences between the rural and urban meal preparation system (Carl, 2015). Consumption analysis, conducted at six sites in the Oklahoma school district, revealed students were consuming three-fourths of the entrée, half the grain component, and less than half of the vegetable and fruit serving. Urban students consumed significantly more entrée than rural students (Carl, 2015). This study proposed future culinary efforts focus on increasing fruit, vegetable, and whole grain components; modifying food preparation methods; and revising menu plans to better incorporate a variety of foods into school lunches. Additionally, it noted the importance of identifying differences between foods served in urban schools versus rural schools and potential strategies used by urban schools to increase student consumption.

Prior to implementation of the pilot chef-led culinary skills training program, school nutrition staff were evaluated using the Community Readiness Model. The model assessed readiness to integrate new preparation methods and federal requirements into menu planning and school lunches received by students (Blevins, 2015). In summer 2014, six Oklahoma school districts received training. Cooking for Kids moved schools from a vague awareness stage, one of precontemplation, to the preparation stage of making changes to existing food preparation practices (Blevins, 2015). The pilot chef-led culinary training program positively impacted school nutrition staff's readiness to acquire new culinary skills and methods of food preparation; staff reported an increase in culinary aptitude and awareness for making dietary changes (Blevins, 2015). Results of this study prompted future Cooking for Kids efforts to focus on customized, individual culinary training programs and school-wide nutrition interventions (Blevins, 2015).

Cooking for Kids Regional Training, offered June and July 2015 at six sites in Oklahoma, reached 291 school nutrition professionals; the program was structured with both lecture and instructional videos, and hands on training and application. Participants completed a culinary skill sets and nutrition attitudes questionnaire Day-1 of the two-day training (Level 1 and Level 2). Level 1 concepts introduced basic nutrition, food safety, knife and kitchen skills, vegetable and whole-grain cookery, and recipe and menu development. Level 2 concepts involved taste testing various foods, professional development, marketing, flavor training, use of recipes, and time management. The same culinary skill sets and nutrition attitudes survey was administered six months post-training. School nutrition professionals reported a significant increase in their beliefs about the health and preparation of foods served and their contribution to the health

and academic performance of students (Till et al., 2017). The study concluded that chef-led programs can successfully equip school nutrition professionals with the knowledge and skills they need to efficiently prepare healthier meals using less processed foods (Till et al., 2017).

As a follow-up to the meal consumption analysis completed in Spring of 2014, another was conducted in Fall 2016 (Powell et al., 2017). In addition, personal interviews were conducted with the Child Nutrition Director at each school to evaluate change in the use of convenience foods from pre- to post-intervention and to determine the extent by which schools incorporated marketing strategies. Initial trials of Cooking for Kids decreased the use of convenience foods to prepare the entrée (Powell et al., 2017). Change did not negatively impact student consumption of the entrée and there was a notable increase in the consumption of whole-grains and fruits (Powell et al., 2017). In contrast, there was an unexpected decrease in the amount of vegetables consumed (Powell et al., 2017). The study recommended schools focus on approaches to increase vegetable consumption and market whole-grains and vegetables (Powell et al., 2017), that which would improve dietary quality of the meal served and subsequently consumed by students.

IV. Assessing Dietary Quality

Dietary quality refers to how closely a diet follows scientifically established and/or government established recommendations for healthy eating; a high quality diet usually includes balance, variety, adequacy, and/or moderation. It assess disease preventive factors of a diet and ensures a healthful state for optimal growth and development (Guerrero & Perez-Rodriquez, 2017). Dietary quality is an assessment tool that can be used to monitor the impact

of dietary modifications; in schools, these modifications may include offering more fruit and vegetable, free drinking water, and low-fat foods, while reducing access to sweetened beverages, added sugars, saturated fats, sodium, and high-calorie foods (Cullen et al. 2006). Methods for assessing dietary quality are aimed at quantifying and evaluating the extent by which real food and nutrient intake comply with reference intake values, National School Lunch Program standards, or specific dietary recommendations (Guerrero & Perez-Rodriquez, 2017).

One method for assessing dietary quality of meals is the United States Department of Agriculture Center for Nutrition Policy and Promotion's Healthy Eating Index. This is an objective measure of overall nutrition quality of a diet compared to the Dietary Guidelines for Americans. The Healthy Eating Index provides a summary score out of 100, with a higher score meaning a healthier diet. To achieve a high score, the diet must include greater quantities of total and whole fruit, total vegetables, dark green and legume vegetables, whole grains, diary, total protein foods, seafood and vegetarian protein options, monounsaturated and polyunsaturated fats, and little saturated fat (Healthy Eating Index, 2015). Also, lower amounts of refined grains, sodium, and empty calories increases the Healthy Eating Index Score (Healthy Eating Index, 2015).

Flexibilities of the National School Lunch Program possibly creating variation in the nutrient content of school lunches and the benefits of high dietary quality school meals has driven research to determine whether or not there is a significant difference in nutrient content and dietary quality of typical school lunches compared to best practice school lunches, which implement all Dietary Guidelines for Americans healthy meal pattern recommendations and Child and Adult Care Food Program best practices. The Typical School Menu was a convenience

sample of six weeks from an actual school menu obtained from a local school district. (Joyce et al., 2018). It met all National School Lunch Program requirements for food group components but, on average, exceeded limits for calories (5% over upper limit of 600-700 calorie range) and saturated fat (14% of calories, over limit of 10% of calories) (Joyce et al., 2018). The Best Practice Menu was created to optimize nutrition based on best practices and may not be currently feasible in school foodservice environments. It was created to include whole fruits and vegetables, all whole grain products, have minimal added fats or sugars, meet the lowest sodium requirement of the original Healthy, Hunger-Free Kids Act (710mg/lunch), be minimally processed and made from scratch, included fish and vegetarian options, and be diverse in color and freshness (Joyce, et al. 2018). It met all National School Lunch Program requirements for food group components, calories (stayed within range of 600-700 calories), saturated fat (less than 10% of calories), trans fat (non, defined as <0.5g by industry standards), and sodium (less than 1360mg) (Joyce et al., 2018). The Best Practice Meal was significantly higher in dietary quality than the Typical School Menu as evident by a 22 percent higher average Healthy Eating Index score, 91.8 ± 5.1 and 75.1 ± 5.8, respectively (Joyce, et al. 2018). Additionally, the Best Practice Menu was lower in calories, saturated fat, sodium, and higher in protein, carbohydrates and fiber than the Typical School Menu. These results indicate the possibility for significant difference in dietary quality between the two meals meeting National School Lunch Program requirements (Joyce, et al. 2018); thus, the Typical School Menu and the Best Practice School Menu were used as comparison values for dietary quality of the present study.

SUMMARY

The Healthy, Hunger-Free Kids Act of 2010 challenged school districts to modify their existing menus to better meet dietary requirements of the Dietary Guidelines for Americans; though nutrition standards required for reimbursement by the National School Lunch Program have improved, the possibility remains for overall dietary quality to vary. Independent chef-led culinary interventions and nutrition education programs emerged across the United States to help schools meet these recommendations and to improve dietary quality and appeal of school lunches. In October 2013, Oklahoma invested in a comprehensive culinary training program focused on mentorship between chef and school nutrition staff, which supports meal preparation in compliance with national standards, culinary self-efficacy growth amongst staff, and healthfulness of the foodservice environment. Since its implementation, Cooking for Kids has prevailed, becoming an integrative part of the National School Lunch Program in several Oklahoma school districts; its chefs train and educate foodservice staff and school nutrition professionals, introduce healthy foods to school menus, and increase appeal to students through high quality meals. The program has been shown to effectively increase acceptability of fruits and vegetables, lessen the quantity of wasted food, and enhance the food environment for both students and staff. However, overall change in dietary quality remains a question of concern. The present study uses nutrient analysis and the Healthy Eating Index to quantify the dietary quality of meals presently served at Middleburg Public School; these values are compared to a Typical School Menu meeting baseline National School Lunch Program standards and Best Practice School Menu optimizing nutrition, to indicate areas of dietary need and improvement. Results of this study helped develop recommendations for Middleburg

Public School during their participation in the Cooking for Kids program and will be used as a baseline comparison for dietary quality after completion of the two-year chef consultation.

METHODS

I. Procedure

To assess dietary quality, secondary data regarding lunch menus, production records, and recipes were collected from Middleburg Public School for the period of March 12-16, 2018. Under the scope of Cooking for Kids, Middleburg Public School agreed to the release of this information for study purposes. The Food Service Director and Cooking for Kids chef worked in collaboration with researchers; they were frequently consulted to obtain detailed information about food items on the menu otherwise not noted or with inadequate detail on the production record. These steps were taken to guide and minimize assumptions made about the menu or production record during the nutrient analysis. These assumptions included that half of grains were whole grains; fruit was canned in 100% fruit juice; vegetables were either canned, pre-packaged, or frozen; the main entrée was pre-prepared, unless indicated by a recipe; salad dressing accompanied the side salad; vegetables were served in 3/4c. portions; and grain, protein, and vegetable requirements were met in a single serving of a food component prepared by the staff, such as spaghetti and meat sauce. Because the school offers its 5^{th}- 8^{th} grade students a salad bar option, the vegetable option listed on the publicly available, online menu was the one chosen for analysis.

Based on assumptions, a meal portion component was assigned to each menu item. Daily nutrient content for all macro- and micro-nutrients was determined for each menu item using

Food Processor Nutrition Analysis Software distributed by ESHA (version 11.6, 2018, Salem, OR). Daily dietary quality was computed for each menu system using the Healthy Eating Index 2015. Healthy Eating Index scores are based on a 5 or 10-point scale for each of the 12 food component or nutrient scoring components per 1000 calories. Since National School Lunch Program reimbursable meals do not meet 1000 calories for K-8th grade, proportions were used to determine what the nutrient or food component quantity would be if the meal had been 1000 calories (Joyce, et al. 2018). Once this number was calculated, it was divided by the scoring component value for the food or nutrient and multiplied by 100 to give what percent of that value the menu met (Joyce, et al. 2018). This percentage was then transferred to a score of matching percent out of 5 or 10 points(Joyce, et al. 2018). The twelve HEI scoring component values were totaled for each of the five days to give a daily Healthy Eating Index score for objective dietary quality.

II. Data Analysis

Descriptive statistics included mean, standard deviation, and range for each of the five meals served and overall menu condition. The Typical School Meals (Joyce, et al. 2018) and Best Practice Meals (Joyce, et al. 2018) were used as standards by which to compare the Middleburg school meals. Independent *t*-tests of mean differences were used to determine significant differences between menu conditions for macro- and micro-nutrients, as well as Healthy Eating Index score. The level of significance was set at $p < 0.05$. Cohen's *d* was calculated for effect size determination for between menu condition differences. Statistical analysis was performed using a TI-84 Plus Graphing Calculator (Texas Instruments).

RESULTS

I. Nutrient Content of Nutrients Monitored by National School Lunch Program

Similarly to the Best Practice Menu and Typical Menu, the Middleburg Menu met all National School Lunch Program requirements for food group components, but, on average over the five-day period, exceeded limits for calories (5% over upper limit of range 600-700 calories) and sodium (30% over limit of 1360mg daily).

II. Nutrient Content of the Typical Menu vs. Middleburg Menu for Nutrients Required for Analysis by National School Lunch Program

Table 1 summarizes the descriptive statistics and comparison of nutrients required by the National School Lunch Program between the Typical Menu (Joyce et al., 2018) and the Middleburg Menu. Overall, the two meal patterns are similar in nutrient content. The Typical Menu and the Middleburg Menu are similar in calories (p = 0.983), protein (p = 0.702), and fiber (p = 0.877). Though not statistically significant, the Middleburg Menu was higher in sodium by 71% (p = 0.33, mean difference = 731mg) and carbohydrates by 26% (p = 0.372, mean difference = 20.3g). The Middleburg Menu was significantly lower in saturated fat (p = 0.009, Cohen's d = 1.14) and trans fat (p = 0.000, Cohen's d = 0.43) than the Typical Menu.

TABLE 1 Typical Menu vs. Middleburg Menu for Nutrients Required by NSLP

Nutrient	National School Lunch Program Standard	Typical Menu†		Middleburg Menu		Mean Difference‡	p-Value	Cohen's d
		Mean	SD	Mean	SD			
Calories	600-700 kcal	733.7	154.3	730.9	215.4	2.8	0.983	0.01
Protein (g)	9-10 oz per week	29.6	3.67	32.4	15.4	-2.8	0.702	0.25
Carbohydrate (g)	8-10 oz per week	76.6	16.2	96.9	44.8	-20.3	0.372	0.60
Saturated Fat (g)	<10% calories (<6.7-7.8g)	9.5	3.2	6.6	1.6	2.9	0.009*	1.14
Trans Fat (g)	0	0.3	0.3	0.17	0.3	0.13	0.000*	0.43
Sodium (mg)	<1360	1030.5	235.9	1761.5	1479.5	-731.0	0.001*	0.69
Fiber (g)	1/2 grains whole grain	6.4	2.1	6.8	4.9	-0.4	0.879	0.11
HEI Score		75.1	5.8	65.8	13.8	9.3	0.211	0.878

* Results considered significant if p < 0.05
† Typical Menu (Joyce, et al. 2018)
‡ Mean Difference = Typical Menu – Middleburg Menu

III. Nutrient Content of the Best Practice Menu vs. Middleburg Menu for Nutrients Required for Analysis by National School Lunch Program

Table 2 summarizes descriptive statistics and comparison of the Best Practice Menu and the Middleburg Menu for nutrients required by the National School Lunch Program. The Middleburg Menu was similar in protein (p = 0.683), carbohydrates (p = 0.662), and saturated fat (p = 0.999) when compared to the Best Practice Menu. Though not statistically significant, the Middleburg Menu, on average, was 15% higher in calories (p = 0.481, mean difference = 93.3kcal). Between the two meal patterns, the Middleburg Menu was significantly lower in trans fat (p < 0.001, Cohen's d = 0.10) and fiber, by 60% (p = 0.009, Cohen's d = 1.02); but exceeded sodium of the Best Practice Menu by 212% (p = 0.144, mean difference = 1198.7mg, Cohen's d = 1.14).

TABLE 2 Best Practice Menu vs. Middleburg Menu for Nutrients Required by NSLP

Nutrient	National School Lunch Program Standard	Best Practice†		Middleburg Menu		Mean Difference‡	p-Value	Cohen's d
		Mean	SD	Mean	SD			
Calories	600-700 kcal	637.6	31.1	730.9	215.4	-93.3	0.481	0.61
Protein (g)	9-10 oz per week	35.6	6.09	32.4	15.4	3.2	0.683	0.29
Carbohydrate (g)	8-10 oz per week	87.4	11.3	96.9	44.8	-9.5	0.662	0.29
Saturated Fat (g)	<10% calories (<6.7-7.8g)	6.6	3.1	6.6	1.6	0.0	0.999	0.00
Trans Fat (g)	0	0.2	0.3	0.17	0.3	0.03	0.000*	0.10
Sodium (mg)	<1360	562.8	139.6	1761.5	1479.5	-1198.7	0.144	1.14
Fiber (g)	1/2 grains whole grain	16.0	11.7	6.8	4.9	9.2	0.009*	1.02
HEI Score		91.8	5.1	65.8	13.8	26.0	0.012*	2.49

* Results considered significant if p < 0.05
† Best Practiced Menu (Joyce, et al. 2018)
‡ Mean Difference = Best Practice Menu – Middleburg Menu

IV. Nutrient Content of Other Macro- and Micronutrients of Concern for Typical Menu vs. Middleburg Menu

Table 3 presents the descriptive statistics and comparison between the Typical Menu and the Middleburg Menu for other nutrients of concern not monitored by the National School

Lunch Program. There were differences between menu conditions of the Typical Menu and the Middleburg Menu for 4 of the 15 nutrients not required for analysis by the National School Lunch Program. The Middleburg Menu and the Typical Menu were fairly similar in sugar (p = 0.550), Vitamin D (p = 0.864), Vitamin B12 (p = 0.380), iron (p = 0.613), calcium (p = 0.562), and magnesium (p = 0.562). However, the Middleburg Menu was noticeably lower, but not statistically different, in polyunsaturated fat by 35% (p = 0.322, mean difference = 1.7g), folate by 23% (p = 0.174, mean difference = 26.9mcg), phosphorus by 17% (p = 0.211, mean difference = 87.7mg), and zinc by 26% (p = 0.198, mean difference = 1.0g). The Middleburg Menu was higher, but not statistically different, in total fat (p = 0.08, mean difference = 7.1g). The Middleburg Menu was significantly lower in monounsaturated fat (p = 0.001, Cohen's d = 1.78,), cholesterol (p = 0.04, Cohen's d = 1.19), Vitamin A (p < 0.001, Cohen's d = 0.89), and Vitamin C (p < 0.001, Cohen's d = 2.06) compared to the Typical Menu.

TABLE 3 Typical Menu vs. Middleburg Menu for Nutrients Not Required by NSLP

Nutrient	Typical Menu†		Middleburg Menu		Mean Difference‡	p-Value	Cohen's d
	Mean	SD	Mean	SD			
Total Fat (g)	22.9	8.1	30.0	6.9	-7.1	0.082	0.94
Monounsaturated Fat (g)	7.5	2.2	3.2	2.6	4.3	0.001*	1.78
Polyunsaturated Fat (g)	4.8	2.3	3.1	3.3	1.7	0.322	0.59
Cholesterol (mg)	72.5	19.0	51.1	16.9	21.4	0.043*	1.19
Sugar (g)	35.0	16.0	32.1	8.0	2.9	0.550	0.23
Vitamin A (IU)	1949.6	1618.0	906.7	344.6	1042.9	0.000*	0.89
Vitamin C (mg)	43.5	24.0	8.5	1.8	35	0.000*	2.06
Vitamin D (IU)	121.0	21.8	119.9	9.7	1.1	0.864	0.06
Folate (mcg)	111.7	33.4	84.8	35.7	26.9	0.174	0.78
Vitamin B12 (mcg)	1.8	0.7	1.4	0.8	0.4	0.380	0.53
Iron (mg)	4.1	0.8	4.6	1.9	-0.5	0.613	0.34
Calcium (mg)	488.4	82.7	454.6	95.6	33.8	0.488	0.38
Phosphorus (mg)	524.2	80.0	436.5	130.4	87.7	0.211	0.81
Magnesium (mg)	88.7	17.3	79.5	31.9	9.2	0.562	0.36
Zinc (mg)	3.8	1.3	2.8	1.4	1.0	0.198	0.76

* Results considered significant if p < 0.05
† Typical Menu (Joyce, et al. 2018)
‡ Mean Difference = Typical Menu – Middleburg Menu

V. Nutrient Content of Other Macro- and Micronutrients of Concern for Best Practice Menu vs. Middleburg Menu

Table 4 presents the descriptive statistics and comparison between the Best Practice Menu and the Middleburg Menu for other nutrients of concern not monitored by the National School Lunch Program. There were significant differences between menu conditions of the Best Practiced Menu and the Middleburg Menu for 7 of the 15 nutrients not required for analysis by the National School Lunch Program. The Best Practice Menu and the Middleburg Menu were fairly similar in polyunsaturated fat (p = 0.946), iron (p = 0.983), and sugar (p = 0.253). Though not statistically different, the Middleburg Menu was lower in Vitamin B12 by 30% (p = 0.137, mean difference = 0.7mcg), calcium by 15% (p = 0.159, mean difference = 79.4mg), zinc by 30% (p = 0.133, mean difference = 1.2), and monounsaturated fat by 193% (p = 0.06, mean difference = 3.0g). The Middleburg Menu was significantly higher in total fat (u = 0.01, Cohen's d = 1.85) and significantly lower in cholesterol (p = 0.02, Cohen's d = 0.89), Vitamin A (p < 0.001

TABLE 4 Best Practice Menu vs. Middleburg Menu for Nutrients Not Required by NSLP

Nutrient	Best Practice Menu†		Middleburg Menu		Mean Difference‡	p-Value	Cohen's d
	Mean	SD	Mean	SD			
Total Fat (g)	18.4	5.6	30.0	6.9	-11.6	0.016*	1.85
Monounsaturated Fat (g)	6.2	2.8	3.2	2.6	3.0	0.061	1.11
Polyunsaturated Fat (g)	3.2	2.1	3.1	3.3	0.1	0.946	0.03
Cholesterol (mg)	78.9	40.7	51.1	16.9	27.8	0.020*	0.89
Sugar (g)	37.1	8.1	32.1	8.0	5.0	0.253	0.62
Vitamin A (IU)	6674.7	6867.8	906.7	344.6	5768	0.000*	1.18
Vitamin C (mg)	81.8	91.6	8.5	1.8	35	0.000*	1.13
Vitamin D (IU)	142.1	33.7	119.9	9.7	22.2	0.007*	0.89
Folate (mcg)	132.4	76.6	84.8	35.7	47.6	0.045*	0.79
Vitamin B12 (mcg)	2.1	0.8	1.4	0.8	0.7	0.137	0.88
Iron (mg)	4.6	1.3	4.6	1.9	0.0	0.983	0.00
Calcium (mg)	534.0	153.6	454.6	95.6	79.4	0.159	0.62
Phosphorus (mg)	855.6	100.7	436.5	130.4	419.1	0.001*	3.59
Magnesium (mg)	154.4	32.2	79.5	31.9	74.9	0.003*	2.33
Zinc (mg)	4.0	1.2	2.8	1.4	1.2	0.133	0.92

* Results considered significant if p < 0.05
† Best Practiced Menu (Joyce, et al. 2018)
‡ Mean Difference = Best Practice Menu – Middleburg Menu

Cohen's d = 1.18), Vitamin C ($p < 0.001$, Cohen's d = 1.13), Vitamin D ($p = 0.007$, Cohen's d = 0.89), folate ($p = 0.045$, Cohen's d = 0.79), phosphorus ($p = 0.001$, Cohen's d = 3.59), and magnesium ($p = 0.003$, Cohen's d = 2.33) than the Best Practice Menu.

VI. Overall Dietary Quality

The calculated HEI Score for the Middleburg Menu was 65.8 ± 13.8. The Typical Menu had higher overall dietary quality than the Middleburg Menu as evidenced by a 12% higher average HEI Score of 75.1 ± 5.8 ($p = 0.211$), though not statistically significant. The Best Practice Menu had significantly higher overall nutritional quality than the Middleburg Menu as evidenced by a 30% high average HEI Score of 91.8 ± 5.1. The difference in dietary quality between the Best Practice Menu and the Middleburg Menu was very large (Cohen's d = 2.49).

DISCUSSION

The purpose of this study was to determine whether there were significant differences in nutrient content and dietary quality between a one-week Middleburg School Lunch menu when compared to a Typical Lunch Menu and a Best Practice Lunch Menu (Joyce et al., 2018). As did the Typical Menu and the Best Practice Menu, the Middleburg Menu met all National School Lunch Program requirements. Whole fruit, vegetable variety, and protein components, those required by the National School Lunch Program as components of a standard school meal, increased the Middleburg HEI Score, as well as, there being no trans fat, little added sugars, and the inclusion of dairy, daily, into their school menu. Though Middleburg Public School met National School Lunch Program requirements for these components, there were some slight variations. A notable difference between the Typical Menu and the Middleburg Menu was the Middleburg Menu was lower in saturated fat; maintenance of saturated fat below 10% of meal calories further increased the Middleburg HEI score. While there was no significant difference in sodium levels, the Middleburg Menu exceeded the National School Lunch Program standard, whereas the Typical Menu and the Best Practice Menu did not; sodium content greater than the 1360mg standard drove the Middleburg HEI score down. For other macro- and micronutrients, monounsaturated fat was significantly higher in the Typical Menu than the Middleburg Menu; absence of healthy fatty acids in the Middleburg Menu, though not required by the National School Lunch Program, decreased the HEI score. The Best Practice Menu was significantly higher in Vitamin A, Vitamin C, and folate, nutrients found in dark leafy greens, fruits, and vegetables. The Middleburg Menu's inability to meet all five vegetable subgroups, particularly dark greens and beans, further lowered the Middleburg HEI

Score. Overall, results indicate similarities in dietary quality between the Typical Menu and the Middleburg Menu (75.1 $\pm$ 5.8, p = 0.211) but a significant difference in dietary quality between the Best Practiced Menu and the Middleburg Menu (91.8 $\pm$ 5.1, p = 0.012). These results convey a school lunch created with the goal of optimizing dietary quality would provide statistically and clinically higher dietary quality to students than a Typical School Menu or the present Middleburg School Lunch Menu.

I. Implications of Improved Dietary Quality in School Lunches

There are many benefits to improving dietary quality of school lunches. First, one goal of the Healthy, Hunger-Free Kids Act was to reduce childhood obesity. Dietary quality is negatively associated with child and adult adiposity and cardiovascular and metabolic diseases (Perry et al., 2015)(Dahm et al., 2016). Additionally, higher dietary quality is associated with lower BMI and recued insulin resistance. Less low-density lipoproteins and more high-density lipoproteins were observed among individuals with better overall dietary quality; they were at lower risk for cardiovascular disease, hyperlipidemia, and liver and kidney damage (Phillips, et al. 2018). Individuals who consumed a DASH diet, one of notably high dietary quality, had lower likelihood of developing central obesity and metabolic syndrome (Phillips et al., 2018). Improving dietary quality in people with Type 1 or Type 2 Diabetes and those predisposed to the condition has been shown to improve long-term vascular health (Petersen, 2018). Second, dietary quality is positively correlated with performance in the educational setting. Increased dietary quality is associated with less student failure in literacy assessment (Florence et al., 2008) and math and language arts (Correa-Burrows et al., 2016), as well as higher scores in

reading fluency and comprehension (Haapala et al., 2017). Educational outcomes improved significantly in English and Science subjects with higher dietary quality (Belot & James, 2011). Diets with variety, those specifically rich in fruits and vegetables, are most significantly associated with higher academic achievement (Florence et al., 2008). Increased fruit and vegetable intake (Kristjansson et al., 2010) and a diet rich in energy, protein, riboflavin, Vitamin C, Vitamin A, iron, and calcium (Ivanovic, 1992), as seen in high dietary quality diets, is positively correlated with academic achievement and higher test scores than peers. Cross-sectional studies evaluating effects of high nutritional quality school lunches on child behavior and cognitive development found that school lunches of high dietary quality are positively correlated with classroom alertness (Golley et al., 2010). Dietary modifications to the food and the dining environment in secondary schools is positively related to student on-task concentration and learning behaviors (Storey et al., 2011) and fewer authorized absences, those linked to illness and health complications (Belot & James, 2011). Also, good dietary habits ensure optimal mental and behavioral performance in school and prevent long-term cognitive and behavioral problems in children, especially students with poor dietary quality or of low socio-economic status (Bellisle, 2004). Secondary school interventions designed to keep children at a healthy weight and high academic status, significantly decreased BMI and blood pressure (Hollar et al., 2010) and increased academic scores among low-income children (Gomez-Pinilla, 2008). Additionally, they prevented learning declination, stimulated memory retention, and reduced aggression, disciplinary problems, and school suspensions (Brown et al., 2008).

Although optimizing dietary quality of school lunches has positive qualities, there are barriers to change. First, principals', dietitians', and food service managers' perceptions of dietary quality pose as potential barriers in schools. Discrepancies exist between government and public health officials and school personnel on perceptions of the obesity epidemic, student health behaviors, and the quality of food being offered in cafeterias; this inhibits collaborative interventions to address obesity and other health epidemics through dietary modifications to the school environment (Nollens et al., 2007). Additionally, perceptions are that school lunch participation rates remain high despite inadequate resources to implement wellness initiatives (Nollens et al., 2007); majority of school nutrition personnel express satisfaction with their food service program (Nollens et al., 2007). Barriers among food service personnel to improving the dietary quality of school meals include low priority for health promotion due to lack of time; lack of nutrition education for students, staff, community, and parents (Brouse et al., 2009); and increased cost of fruits and vegetables, perishable nature of wholesome foods, and difficulty obtaining healthy items (Crooks, 2003). Other potential barriers are rising meal costs and budgetary constraints that compel schools to find additional funding to support nutrition programs (Lytle et al., 2003) and that add pressure to serve what is liked by students rather than what is healthy due to financial restraints and need for student participation to receive National School Lunch Program funding (Brouse et al., 2009). Also, most staff are unaware that schools have the responsibility to provide healthful foods to students and have the influence to make healthful recommendations to students. Barriers to offering nutritious foods to students include student perception of the unfamiliar foods and the staff leeriness to stress dietary quality as part of their job (Perera et al., 2015). Thus, numerous barriers to implementation of

higher dietary quality lunches within schools exist. As the aim of this current study was to compare potential differences in dietary quality of the Middleburg Menu to a Typical Menu and a Best Practice Menu, and significant differences were found, overcoming these barriers when transforming the food preparation and dining environment of Middleburg Public School will be a priority of Cooking for Kids culinary training program.

II. Improving Dietary Quality with National School Lunch Program Guidelines and Resources

As highlighted in the literature review of this article, the National School Lunch Program guidelines have evolved across the recent years; there is research to suggest these changes are improving the nutritional quality and student receptiveness of school lunches (Mozaffarian, 2017) (National Cancer Institute). First, the 2012 National School Lunch Program dietary requirements differ greatly from those prior to the Healthy Hunger-Free Kids Act. Prior guidelines used traditional, food-based menu planning, had no sodium or calorie cap, required less than 30% of calories from fat, less than 10% of calories from saturated fat, and at least one-third of the Recommended Dietary Allowance from protein, iron, calcium, vitamin A, and vitamin C, with no food group specifications (Health.gov)(School Nutrition Association, 2014). Moving away from nutrient content to specific food group components, the 2012 National School Lunch Program nutrition standards include additional requirements: at least half grains be whole-grain rich, sodium be restricted, and milk be low-fat or fat-free (United States Department of Agriculture, 2017). These changes have allowed for greater focus on quality foods within specific food groups rather than individual nutrients. Such transitions are

supported in the present research study; the Healthy Eating Index scoring system used to analyze and compute dietary quality for the data of this study focuses mainly on food components rather than individual nutrients. Modern nutritional evidence indicates in order to prevent chronic diseases, such as cardiovascular disease, diabetes, and obesity, the prevailing focus needs to shift away from simply calorie counting and towards overall diet quality and food patterns. Rather than decreasing calories and individual nutrients in school lunch menus, efforts should be aimed at increasing the proportion of calories consumed from healthy foods, such as fruits, vegetables, beans, nuts, seeds, fish, vegetable oils, low-fat dairy and minimally processed whole-grains (Mozaffarian, 2017), the components evaluated by the Healthy Eating Index (Reedy et al., 2015). Though all calories are considered equal, large quantities of low nutrient-dense foods can lead to weight gain and disease progression, whereas equal caloric amounts of high dietary quality foods can lead to weight loss and disease preventative effects (Mozaffarian, 2017). Thus, there is a need for schools, as they implement nutrition standards of the National School Lunch Program, to shift away from fixation on total calories, total fat, and individual nutrients to considering overall dietary quality and meal patterns (Joyce et al., 2018). Such improvements have the potential to lower nutrition-related health outcomes, disease risk, and improve the health of school-aged children (Joyce et al., 2018).

Alongside National School Lunch Program guideline improvements, schools are making progressive efforts to improve nutrition quality of foods offered and get students involved in making healthier food choices. With implementation of more rigorous nutrition standards, the number of schools reporting no-candy or regular fat snacks, no higher fat milks, more fruits and

vegetables and whole grains has increased. Research conducted in 2011 and 2012, shortly after the Healthy, Hunger Free Kids Act of 2010, found that children served meals meeting new standards ate greater proportions of their entrees and vegetables than they had when given meals of the old standards; also, the children ate more fruits under the new mandate (Woo, et al. 2014). A national survey conducted by the National School Association from 2014 to 2016 of almost 1000 school meal program operators found increased efforts by schools to promote healthy food choices to students after the latest revisions to the National School Lunch Program guidelines (Pratt-Heavner, 2016); also, after the Smart Snacks in School Regulation, which required all foods sold during the school day (i.e. those sold a la carte, in the student store, in vending machines, and at other venues) to meet nutrition standards (United States Department of Agriculture, 2019). Initiatives to market and increase appeal of healthier food choices to the student population increased significantly. The National School Lunch survey also showed that 66% of schools offered a salad bar, 57% offered locally grown produce, a growing number of school districts implemented Farm to School programs, involved students in food sampling and taste tests, developed partnerships with chefs, underwent recipe and menu development training, or had intentions to begin such planning or initiatives (Pratt-Heavner, 2016). Additionally, implementation of the Healthy, Hunger Free Kids Act has resulted in improvement in the nutritional quality of students' food choices, with negligible differences in meal participation (Johnson et al., 2016). The majority of studies indicate that increasing access to healthy foods during school lunch improved student dietary intake and food consumption behaviors, such as increased selection, intake, and sales of healthy foods and decreased plate waste (Mansfield & Savaiano, 2017). The percentage of schools offering healthful items, such

as vegetables, fresh fruit, salad bars, whole grains, and more nutrient-dense entrees increased significantly from 2006-2007 to 2013-2014, and the percentage of schools offering less healthful items, such as fried potatoes, regular pizza, and high-fat milks decreased significantly (Turner et al., 2016). These studies indicate that the National School Lunch Program has improved tremendously from previous standards, in ways that schools offer healthy foods, increase quality of child dietary intake, and positively enhance the school dining environment.

The programs listed above are some of the few ways schools have attempted to improve nutritional quality and increase dietary intake of school lunches; however, our focus is the Oklahoma, chef-led culinary training program, Cooking for Kids. The accredited program is notable for its ability to help school districts make the sometimes difficult transition to new National School Lunch Program standards and improve dietary quality of school lunches through imitation of the Healthy Eating Index recommendations, and those of other USDA programs, such as the Dietary Guidelines for Americans and the Child and Adult Care Food Program. These practices include inclusion of fresh, whole fruits and vegetables, greens and beans, whole grains, low-fat dairy, total protein foods, seafoods and alternative plant-based protein sources, and omega-3 and omega-6 fatty acids (Reedy et al., 2015). Also, practices include sparing refined grains, sodium, added sugars, and saturated fats (Reedy et al., 2015); making all grains whole grains, switching from canned foods and vegetables to plain or frozen, ordering locally sourced produce, omitting processed meats and cheeses, serving nuts, low-fat and reduced-fat cheese, lean meats, and fish; and avoiding non-creditable foods with added sugars (United States Department of Agriculture, n.d.). As Cooking for Kids begins its culinary training and implementation in Middleburg Public School, these small steps taken by the school

should improve dietary quality and nutrient content of their school lunches, with efforts to best meet National School Lunch Program standards and improve student health and satisfaction.

III. Strengths

The current study has several strengths worth mentioning. First, researchers obtained as much information as possible from Middleburg school district to make nutrient analysis as accurate as possible. Unlike the Typical Menu (Joyce et al., 2017) and the Best Practice Menu (Joyce et al., 2017) used during statistical analysis, fewer assumption were made about the menu products because researchers in the present study had recipes, nutrition facts labels, and production records for reference. The Middleburg Menu was an actual school lunch menu; whereas, the Typical Menu and the Best Practice Menus were theoretically assumed menu conditions; researchers were unable to obtain exact product information for accurate analysis. Any assumptions made when conducting dietary analysis were clearly stated and were made conservatively, favoring higher nutritional quality.

IV. Limitations

There are a few limitations which should be considered with interpreting the findings of the present study. Dietary quality for Middleburg Public School was analyzed over a five-day period, unlike the Typical Menu and the Best Practice Menu, which were six-week, thirty-day menus; the small sample size could have very well skewed results from statistical analysis and may not be reflective of the overall nutritional content and dietary quality of the school's meals. Instead of a t-test, it may have been best to use a non-parametric test. Additionally,

some of the production records did not list quantity for the food component served; therefore, the portion size required by National School Lunch Program guidelines was assumed unless specified otherwise. The lack of serving size specificity, leaves uncertainty as to if students were actually served more or less of a given food component; this too, could have skewed results of statistical analysis, and either increased or decreased the overall nutritional content and dietary quality of the Middleburg school meals.

V. Conclusion

The present study sought to evaluate nutritional content and dietary quality of the Middleburg School Lunch Menu prior to implementation of the Cooking for Kids culinary training program, as well as compare the dietary quality and nutrient content of the Middleburg Menu to the Typical Menu meeting baseline National School Lunch Program standards (Joyce et al., 2017), and the Best Practice Menu optimizing dietary quality regardless of feasibility (Joyce et al., 2017). Based on the findings of the current study, Middleburg Public School would greatly benefit from the optimization of dietary quality of their school lunches. Previous evidence indicates that such improvements in school lunch dietary quality is associated with positive health, educational, and behavioral outcomes. Although there are benefits to making nutritional improvements, potential barriers may hinder the success of this program, such as school support, financial restraints, and healthy food access. However, despite potential barriers, National School Lunch Program requirements are improving and programs are emerging across the United States to help schools put into effect these healthy changes. Aided by Dietary Guidelines for Americans recommendations and best practices,

small, realistic changes Middleburg Public School can make through their participation of Cooking for Kids are presented next in this paper; these changes may provide students with significantly higher dietary quality and academic opportunities. After Middleburg Public Schools participates in Cooking for Kids, future research should analyze change in dietary quality and nutritional content of the school lunch menu post-culinary intervention. Additionally, it may be beneficial to analyze student dietary intake, comparing student consumption prior to and post-culinary training. These results would be particularly helpful in scientifically presenting how collaboration between chef and school can improve dietary quality and student meal consumption patterns, which in turn, can lead to future funding and implementation of these culinary training programs across school districts in Oklahoma.

IMPLICATIONS FOR MIDDLEBURG PUBLIC SCHOOL

Based on the results of the present study, implementing a few small changes could result in significant improvements to the dietary quality and nutrient content of Middleburg school lunches (Reedy, et al. 2018)(United States Department of Agriculture)(Health.gov).

- Making all grains whole grains to increase dietary fiber.
- Switching from canned fruits and vegetables to fresh or frozen fruits and vegetables has the potential to increase vitamin A and C and decrease added sugar and sodium, which would increase dietary quality.
- Choosing lean proteins and low-fat dairy, which will reduce saturated fat and increase dietary quality related to saturated fat. Additionally, an increase in total protein has the potential to increase magnesium, phosphorus, calcium, and Vitamin B12, and dietary quality.
- Serving plant-based proteins (nuts, legumes, avocado, beans, or seeds) to increase mono- and poly-unsaturated fats and dietary quality score.
- Limiting processed meats and cheeses and instead serving nuts, seeds, legumes, lean meats, fish or plant-based proteins, and natural, low-fat or reduced fat cheeses.
- Not serving noncreditable foods with added sugars or trans fats.
- Refraining from frozen entrees and canned goods to reduce sodium.
- Diversifying the protein component of the meal; moving away from frozen-prepackaged breaded meats and poultry to fresh meats, fish, and plant-based proteins.

- Diversifying vegetable component of the meal; supplementing starchy vegetables with more red-orange, leafy greens, or legumes, so long as all five vegetable sub-groups are met on a weekly basis.

These are easy, small, feasible changes Middleburg Public School would introduce to their school lunch menu, which could potentially increase their Healthy Eating Index score for dietary quality. For example, switching from canned fruits to fresh fruits can increase the Healthy Eating Index score by 7%, or 5 points out of 100 (Joyce, et al. 2018); diversifying the vegetable component of the meal to include more dark green, leafy vegetables and legumes would yield similar results, only if the school is over-serving starchy vegetables. Switching from refined grains to whole grains, entirely, can raise the Healthy Eating Index score 14%, as much as 10 points out of 100. If these minor changes are made to the present Middleburg Menu to mimic that of the Best Practice Menu, Healthy Eating Index scores could increase as much as 30%, or 26 points out of 100. Middleburg Public School, making these minimal yet significant changes, would greatly increase dietary quality of their school meals and their food service environment; considering, the average U.S. child's diet has an overall Healthy Eating Index score of 53 points out of 100 (Hiza, 2013). These dietary quality improvements would result in improved health and academic outcomes associated with dietary quality amongst schoolchildren (Joyce, et al. 2018). Hopefully, most of these suggested changes will be introduced to Middleburg Public School as part of the Cooking for Kids curriculum and training.

A negative perception of healthier school lunches is a barrier many food programs must overcome to successfully implement the recommendations mentioned above (Brouse, et al. 2009). Cooking for Kids will need positive outlooks from not only the foodservice department

staff, school administrators, and teachers, but also its students, parents, and community members. The methods by which Cooking for Kids assists Oklahoma schools in the implementation of the National School Lunch Program guidelines and improves dietary quality is a gradual process; Cooking for Kids staff work alongside child nutrition professions to make long-term positive changes in Oklahoma School Lunch Programs. The culinary training process Middleburg Public School will receive looks similar to the following:

- Step 1: Skill Development Training – In this program, school staff learn how to review and taste new recipes; strengthen food safety, knife skills and mise en place; effectively use flavor-enhancing herbs and spices; and increase the availability of whole grains and vegetables. This session focuses on training staff to be both competent in the food preparation process and the dietary and sensory quality of the meal offered to students.
- Step 2: Nutrition Leadership Training – This program examines alternative serving methods, recipes, and menus schools can use to diversify and improve nutritional content of their meals. Here is where schools can be creative and introduce new foods to students in their menu planning.
- Step 3: On-Site Chef Consultation: This program is a series of on-site consults during the school year. A professional chef teaches foodservice staff and nutrition professionals how to develop a menu, assess procurement and equipment, develop work schedules, and implement a marketing plan. This is the program Middleburg Public Schools is about to participate in.

As Middleburg Public School begins their on-site chef consultation with Cooking for Kids, the aim will be to increase dietary quality and nutrient content, increase availability of freshly

prepared foods, increase student participation in school meals, and expand public support of child nutrition programs, such as Cooking for Kids.

REFERENCES

Avey, T. (2015). The History of School Lunch. PBS Food. Retrieved from http://www.pbs.org/food/the-history-kitchen/history-school-lunch/

American Society for Nutrition. (2017). The Future of the National School Lunch Program. Retrieved from https://nutrition.org/the-future-of-the-national-school-lunch-program/

Anderson, M. L., Gallagher, J. Ramirez, E. (2017). School Lunch Quality and Academic Performance. *The National Bureau of Economic Research*. NBER Working Paper No. 23218.

Bellisle, F. (2004). Effects of diet on behavior and cognition in children. *British Journal of Nutrition.* 92(2): 227-232.

Belot, M. & James, J. (2011). Healthy school meals and educational outcomes. *Journal Health Economy*. 30:489-504.

Bevans, K. B., Sanchez, B., Teneralli, R., Forrest, C. B. (2011). Children's Eating Behaviors: The importance of nutrition standards for foods in school. *Journal of School Health*. 81(7).

Blevins, P. A. (2015) "Use of the Community Readiness Model to develop and evaluate Cooking for Kids: Culinary Training for School Nutrition Professionals" Master's thesis, Oklahoma State University. Retrieved from https://shareok.org/bitstream/handle/11244/33392/Blevins_okstate_0664M_13829.pdf?sequence=1&isAllowed=y

Brouse, C. H., Wolf, R. L., Basch, C. E. (2009). School food service directors' perceptions of barriers to and strategies for improving the school food environment in the United States. *International Journal Health Promoting Education*. 47(3): 88-93.

Brown, J. L., Beardslee, W. H., & Prothrow-Stith, D. (2008). Impact of school breakfast on learning: an analysis of the scientific research. *Sodexo Foundation*. Retrieved from http://us.stop-hunger.org/files/live/sites/stophunger-us/files/HungerPdf/Impact%20of%20School%20Breakfast%20Study_tcm150-212606.pdf

Cappelliano, K. (2011). Let's move. Tools to fuel a healthier population. *Nutrition Today*. 46(3): 149-154.

Caraher, M., Seeley, A., Wu, M., and Lloyd, S. (2012). When Chefs adopt a school? An evaluation of a cooking intervention in English primary schools. *Appetite*. 62: 50-59.

Carl, L. (2013). Baseline Study of student's consumption of school lunch meal components prior to implementation of the Cooking for Kids: Culinary Training for Oklahoma School Nutrition Professionals. *ProQuest Dissertations Publishing*.

Cohen, J. F. W., Smit, L. A., Parker, E., Austin, S. B., Frazier, A. L., Economos, C. D., Rimm, E. B. (2012). Long-term impact of a Chef on School Lunch Consumption: Findings from a 2-year pilot study in Boston Middle Schools. *Journal of the Academy of Nutrition and Dietetics*. 112(6): 927-933.

Condrasky, M. D., Griffin, S. G., Catalano, P. M., Clark, C. (2010). A Formative Evaluation of the Cooking with a Chef Program. *Journal of Extension*. 48(2).

Cooking for Kids. Retrieved December 30, 2018 from https://cookingforkids.ok.gov/about

Correa-Burrows, P., Burrows, R., Blanco, E. et al. (2016). Nutritional quality of diet and academic performance in Chilean students. *Bull World Health Organization*. 94: 185-192.

Crooks, D. L. (2003). Trading nutrition for education: nutritional status and the sale of snack foods in an eastern Kentucky school. *Medical Anthropology*. 17(2): 182-199.

Cullen, K. W., Hartstein, J., Reynolds, K. D., Vu, M., Resnicow, K., Greene, N., White, M. A. (2007). Studies to Treat or Prevent Pediatric Type 2 Diabetes Prevention Study Group. Improving the school food environment: results from a pilot study in middle schools. *Journal of the American Dietetic Association*, *107*(3), 484-9.

Dahm, C. C., Chomistek, A. K., Jakobsen, M. U., et al. (2016). Adolescent diet quality and cardiovascular disease risk factors and incidence cardiovascular disease in middle-aged women. *J Am Heart Association*. 5(12): 1-10.

ESHA Research. (2019). Food Processor Nutrition Analysis Software.

Federal Register. (2018). Child Nutrition Programs: Flexibilities for Milk, Whole Grains, and Sodium Requirements. Retrieved from https://www.federalregister.gov/documents/2018/12/12/2018-26762/child-nutrition-programs-flexibilities-for-milk-whole-grains-and-sodium-requirements

Florence, M. D., Asbridge, M. & Veugelers, P. J. (2008). Diet quality and academic performance. *J Sch Health*. 78: 209-215.

Food Research & Action Center. (2018). Benefits of School Lunch. Retrieved from http://www.frac.org/programs/national-school-lunch-program/benefits-school-lunch

Food Research & Action Center. (2018). School Meals Legislation and Funding by State 2016-2017. Retrieved from http://frac.org/wp-content/uploads/state_leg_table_scorecard.pdf

Gomez-Pinilla, F. (2008). Brain foods: The effects of nutrients on brain functions. *Nature Reviews Neuroscience.* 9(7): 568-578.

Golley, R., Baines, E., Bassett, P., Wood, L., Pearce, J., Nelson, M. (2010). School lunch and learning behavior in primary schools: an intervention study. *European Journal of Clinical Nutrition*. 64: 1280-1288.

Guerrero, M. L. P. & Perez-Rodrequez, F. (2017). Diet Quality Indices for Nutrition Assessment: Types and Application. *IntechOpen*, DOI: 10.5772/intechopen.69807. Retrieved from https://www.intechopen.com/books/functional-food-improve-health-through-adequate-food/diet-quality-indices-for-nutrition-assessment-types-and-applications

Haapala, E. A., Eloranta, A. M., Venalainen, T. et al. (2017). Diet quality and academic achievement: a prospective study among primary school children. *European Journal of Nutrition*. 56(7): 2299-2308.

Health. gov. Dietary guidelines for Americans 2015-2020. Retrieved from: https://health.gov/dietaryguidelines/2015/

Hollar, D., Lombardo, M., Lopez-Mitnik, G., Hollar, T., Almon, M., Agatston, A., Messiah, S. (2010). Effective multi-level, multi-sector, school-based obesity prevention programming improves weight, blood pressure, and academic performance, especially among low-income, minority children. *Journal of Health Care for the Poor and Undeserved*. 21(2): 93-108.

Hoy, I. K. (2017). FP5 Integrated culinary skills and school food environment intervention training and plate waste in school lunchrooms – a review of preliminary results from South Carolina's Team Nutrition efforts. *Journal of Nutrition Education and Behavior*. 49(7S1).

Johnson, A. (2018). Get to know your school lunch program. Academy of Nutrition and Dietetics. Retrieved from https://www.eatright.org/food/nutrition/eat-right-at-school/get-to-know-your-school-lunch-program

Johnson, D. B., Podrabsky, M., Rocha, A., Otten, J. J. (2016). Effect of the Healthy Hunger-Free Kids Act on the nutritional quality of meals selected by students and school lunch participation rates. *JAMA Pediatrics*. 170(1):e153918

Joyce, J. M., Rosenckranz, R. R., Rosenkranz, S. K. (2018). Variation in Nutritional Quality of School Lunches with Implementation of National School Lunch Program Guidelines. Journal of School Health. 88(9): 636-643.

Just, D. R., Wansink, B., and Hanks, A. S. (2014). Chefs move to schools. A pilot examination of how chef-created dishes can increase school lunch participation and fruit and vegetable intake. *Appetite*. 83: 242-247.

Kristjansson, A. L., Sigfusdottir, I. D., & Allegrante, J. P. (2010). Health behavior and academic achievement among adolescents: the relative contribution of dietary habits, physical activity, body mass index, and self-esteem. *Health Education Behaviors*. 37:51-64.

Lytle, L. A., Ward, J., Nader, P. R., Pedersen, S., Williston, B. J. (2003). Maintenance of a health promotion program in elementary schools: results from the CATCH-ON study key informant interviews. *Health Education Behaviors*. 30(4): 503-518.

Mansfield, J. L. & Savaino, D. A. (2017). Effect of school wellness policies and the Healthy, Hunger-Free Kids Act on food-consumption behaviors of students, 2006-2016: a systematic review. *Nutrition Reviews*. 75(7): 533-552.

Mozaffarian, D. (2017). Foods, obesity, and diabetes – are all calories created equal? *Nutrition Review*. 75(51): 19-31.

Muzaffar, H., Metcalfe, J. J., and Fiese, B. (2018). Narrative Review of Culinary Interventions with Children in Schools to Promote Healthy Eating: Directions for future research and practice. *Current Developments in Nutrition*. 2(6): nzy016

National Cancer Institute. Comparing the application of the Healthy Eating Index – 2005 and the Healthy eating Index – 2010 in the food shelf setting. Retrieved from https://experts.umn.edu/en/publications/comparing-the-application-of-the-heatlhy-eating-index2005-and-the

Nollen, N. L., Befort, C. A., Snow, P., Daley, C. M., Ellerbeck, E. F., Ahluwalia, J. S. (2007). The school environment and adolescent obesity: qualitative insights from high school principals and food service personnel. *The International Journal of Behavioral Nutrition and Physical Activity*. 4:18-18.

Oklahoma State Department of Education. (2016). Oklahoma Public Schools: Fast Facts 2015-2016. Retrieved from https://sde.ok.gov/sites/ok.gov.sde/files/documents/files/Fast%20Facts%20FY16%20April%2026%202016%20Update%20Spread.pdf

Osganian, S. K., Ebzery, M. K., Montgomery, D. H., Nicklas, T. A., Evans, M. A., Mitchell, P. D., Lytle, L. A., Snyder, M. P., Stone, E. J., Zive, M. M., Bachman, K. J., Rice, R., and Parcel, G. (1996). Changes in the Nutrient Content of School Lunches: Results from the CATCH Eat Smart Food Service Intervention. *Preventative Medicine.* 25: 400-412.

Perera, T., Frei, S., Frei, B., Wong, S. S., Bobe, G. (2015). The role of school foodservice personnel in nutrition education: challenges and opportunities at U.S. elementary schools. *Journal of Health Education Research and Development*. 3:133.

Perry, C. P, Keane, E., Layte, R., Fitzgerald, A.P., Perry, I. J., Harrington, J. M. (2015). The use of a dietary quality score as a predictor of childhood overweight and obesity. *BMC Public Health*. 15: 581-590.

Petersen, K. S., Keogh, J. B., Lister, N. B, Clifton, P. M. (2018). Dietary quality and carotid intima media thickness in type 1 and type 2 diabetes: follow-up of a randomized controlled trial*. Nutrition, Metabolism, and Cardiovascular Diseases.* 28(8): 830-838.

Phillips, C. M., Harrington, J. M., and Perry, I. J. (2018). Relationship between dietary quality, determined by DASH score, and cardiometabolic health biomarkers: a cross-sectional analysis in adults. *Clinical Nutrition*. Retrieved from https://doi.org/10.1016/j.clnu.2018.08.028

Powell, B., Hildebrand, D., Brown, B., and Gates, G. (2017). Evaluation of Cooking for Kids: Culinary training program for Oklahoma school child nutrition professionals on student's consumption of school meals. *Journal of Nutrition Education and Behavior.* 49(7S1):P105

Pratt-Heavner, D. (2016). SNA national survey reveals increased efforts to promote student consumption of healthy choices. Available at https://schoolnutrition.org/NewsPublications/PressReleases/SNANationalSurveyRevealsIncreasedEffortsToPromoteStudentConsumptionOfHealthyChoices/

Ralston, K., Coleman-Jensen, A., Waves, A. (2017). USDA's National School Lunch Program reduces food insecurity. United States Department of Agriculture Economic Research

Service. Retrieved from https://search.proquest.com/docview/1930766944/fulltext/1C09AD47445946EFPQ/1?accountid=4117

Reedy, J., Lerman, J. L., Krebs-Smith, S. M., Kirkpatrick, S. I., Pannucci, T. E., Wilson, M. M., Subar, A. F., Kahle, L. L., Tooze, J. A. (2018). Evaluation of the Healthy Eating Index-2015. *Journal of Academy of Nutrition and Dietetics*. 118(9): 1622-1633.

Richard B. Russel National School Lunch Act. Chapter 281 of the 79th Congress, Approved June 4, 1946, 60 Stat. 230

Bergman, E. A., Englund, T., Taylor, K. W., Watkins, T., Schepman, S., Rushing, K. (2014). School Lunch Before and After Implementation of the Healthy Hunger-Free Kids Act. The Journal of Child Nutrition and Management. 38(2)

School Nutrition Association. (2017). Nutrition Standards for School Meals. Retrieved from https://schoolnutrition.org/uploadedFiles/About_School_Meals/What_We_Do/Nutrition-Standards-for-School-Meals.pdf

School Nutrition Association. (2018). School Meal Trends & Stats. Retrieved December 30, 2018 from (https://schoolnutrition.org/AboutSchoolMeals/SchoolMealTrendsStats/

Storey, H., Pearce, J., Ashfield-Watt, P. A., Wood, L., Baines, E., Nelson, M. (2011). A randomized controlled trial of the effect of school food and dining room modifications on classroom behavior in secondary school children. *European Journal of Clinical Nutrition*. 65(1): 32-38.

Till, J., Hildebrand, D., Brown, B., Gates, G. (2017). Cooking for Kids: Culinary Training for School Nutrition Professionals positively affects school nutrition professionals' culinary practices and beliefs. *Journal of Nutrition Education and Behavior*. 49(7): S106

Turner, L., Ohri-Vachaspati, R., Powell, L., Chaloupka, F. J. (2016). Improvements and disparities in types of foods and milk beverages offered in elementary school lunches, 2006-2007 to 2013-2014. Preventing Chronic Disease. Vol. 13.

United States Department of Agriculture. (2012). Federal Register. Retrieved from https://www.govinfo.gov/content/pkg/FR-2012-01-26/pdf/2012-1010.pdf

United States Department of Agriculture Food and Nutrition Service. (2017). Healthy Hunger-Free Kids Act. Retrieved December 30, 2018 from https://www.fns.usda.gov/school-meals/healthy-hunger-free-kids-act

United States Department of Agriculture. (n.d.). Child and adult care food program: best practices. Retrieved from: hhttps://fns-prod.azureedge.net/sites/default/files/cacfp/CACFP_factBP.pdf

United States Department of Agriculture Food and Nutrition Service. (2017). National School Lunch Act. Retrieved from https://www.fns.usda.gov/nslp/history_5

United States Department of Agriculture. (2017). The National School Lunch Program. Retrieved December 30, 2018 from https://fns-prod.azureedge.net/sites/default/files/cn/NSLPFactSheet.pdf

United States Department of Agriculture Center for Nutrition Policy and Prevention. (2016). Healthy Eating Index. Retrieved from https://www.cnpp.usda.gov/healthyeatingindex

United States Department of Agriculture Food and Nutrition Service. (2015). Statement from Secretary Vilsack on new data showing the vast majority of schools now meet the updated meals standards. Retrieved from https://www.fns.usda.gov/pressrelease/2015/012815

USDA Office of Communication. (2017). USDA unveils historic improvements to meals served in America's schools. *United States Department of Agriculture.* Retrieved from https://www.fns.usda.gov/pressrelease/002312

Woo, B. J. A. & Taveras, E. M. (2014). Protecting Progress against Childhood obesity – the National School Lunch Program. 371(20): 1862-1865.