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Assessment of the University of Kentucky's Nutrition Education Program's Smarter Lunchrooms Pilot Plate Waste Project in Three Kentucky Schools

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ABSTRACT OF CAPSTONE

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The College of Public Health

University of Kentucky

2020

ASSESSMENT OF THE UNIVERSITY OF KENTUCKY'S NUTRITION EDUCATION PROGRAM'S SMARTER LUNCHROOMS PILOT PLATE WASTE PROJECT IN THREE KENTUCKY SCHOOLS

ABSTRACT OF CAPSTONE

A Capstone project submitted in partial fulfillment of the requirements for the degree of Doctor of Public Health in the College of Public Health
at the University of Kentucky

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ABSTRACT OF CAPSTONE

ASSESSMENT OF THE UNIVERSITY OF KENTUCKY'S NUTRITION EDUCATION PROGRAM'S SMARTER LUNCHROOMS PILOT PLATE WASTE PROJECT IN THREE KENTUCKY SCHOOLS

School-based approaches utilizing policy, systems, and environmental strategies are needed to address the complex factors driving childhood obesity. The purpose of this pilot study is to implement Smarter Lunchroom strategies in three participating Kentucky middle schools in 2019 and then assess two outcomes: (1) determine the impact of the intervention on fruit and vegetable purchases and waste, and (2) determine how purchases or waste varied by interventions selected for each setting. After the 6-week intervention, combined we found no statistical significant increases in fruit and vegetable purchasing from pre to post intervention. No statistical significant decreases in fruit and vegetable plate waste from pre to post intervention were found. When stratified by individual school, School 3 was the only participating school that showed a statistical significant change (p = 0.023) from pre to post intervention for fruit and vegetable plate waste. A major limitation is the small sample size. Overall, substantial change was observed. Stratified descriptive statistics showed School 2 decreasing plate waste by 26.83% from pre to post intervention. Implications for future Smarter Lunchroom public health interventions are presented.

KEYWORDS: childhood obesity, smarter lunchroom movement, PSE

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Natalie Caroline Nettleton Jones

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CHAPTER 1

INTRODUCTION

Background: Obesity

The American obesity epidemic persists. In fact, it grows worse by the days and affecting both adults and children. In 2020, the U.S. adult obesity rate stands at the highest ever recorded rate of 42.4% (Hales, 2020). This was the first time the national rate has exceeded the 40% mark, an alarming 26% increase since 2008 (Hales, 2020; Hales, Carroll, Fryar, & Ogden, 2017). Currently, half of all Americans have one or more chronic diseases, often related to poor diet and physical inactivity (Smith et al., 2011). These illnesses include high blood pressure, cardiovascular disease, type 2 diabetes, and stroke (Smith et al., 2011). In 2018, Kentucky's adult obesity rate was 36.6%, which positions Kentucky as the fifth highest out of 50 states and the District of Columbia for adult obesity (State of Obesity, 2019). The percentage of physically inactive Kentuckians was 34.4%, relegating it as the most physically inactive state in the nation (KYNEP, 2018). Kentucky was also ranked in the top 10 states for high percentages of adults with diabetes (12.9%) and adults with hypertension (39.4%) (State of Obesity, 2019).

Rates of childhood obesity are also increasing. The latest data shows that 20.8% of U.S. young people, ages 2 to 19, are obese (State of Obesity, 2019). In Kentucky, at least one out of three (36.9%) Kentucky children are overweight or obese, the second highest rate in the United States (Child and Adolescent Health Measurement, 2017). For both adults and youth, obesity is defined by means of one's body mass index (BMI) (Hales et al., 2017). However, for children obesity is determined by comparing one's weight to one's age population (Ogden, Carroll, Kit, & Flegal, 2014). Furthermore, childhood obesity is established with a BMI of greater than or equal to the age and sex specific 95th percentile of the

2000 Centers for Disease Control and Prevention growth charts (Hales et al., 2017).

Currently, Kentucky ranks third highest for childhood obesity rates in youth ages 10 to 17 among all states and the District of Columbia (Child and Adolescent Health Measurement, 2017). Most alarming, a young overweight or obese person possesses a higher risk for having obesity and associated disease risk as an adult. Childhood obesity is an additional risk factor for numerous adult diseases, such as cancer, cardiovascular disease, and diabetes (Boyer, Nelson, & Holub, 2015; Tyson & Frank, 2018). Moreover, obese children exhibit earlier onset of what historically has been considered adult conditions, including hypertension and high cholesterol (Tyson & Frank, 2018). Nationally, obesity is estimated to increase healthcare spending by $149 billion annually (about half of which is paid for by Medicare and Medicaid) (Hales, 2020). In addition, being overweight or obese is the most common reason young adults are ineligible for military service (State of Obesity, 2019). Most public health experts believe that this rise in obesity, particularly in children, has the potential to not only stop the steady increase in life expectancy rates but also reduce the gains achieved by public health advances over recent years (Y. C. M. D. Wang, McPherson, Marsh, Gortmaker, & Brown, 2011).

Relevant to this study, rural and lower income communities, usually have higher rates of obesity, leading to higher proportions of preventable morbidity and mortality when compared to urban populations (Befort, Nazir, & Perri, 2012). Food insecurity, poverty, and high rates of unemployment also contribute to higher burdens of obesity due to low nutritional diets (Kiang, Krieger, Buckee, Onnela, & Chen, 2019). Food insecurity is defined as households unable to provide adequate food for one or more household members due to inadequate resources (America's Health Rankings, 2018). In 2018, an estimated 37 million Americans, including 11 million children, were food insecure (America's Health Rankings, 2018). The relationship of obesity and diet is further exacerbated by low family earnings (Befort et al., 2012). According to US Census estimates for

2017, the median household income in Kentucky was $48,332, almost 20% lower than the U.S. median household income of $60,336 (U.S. Census Bureau, 2018). Kentucky also has higher percentages of poverty and food insecurity among its population compared to census estimates for the United States overall (KYNEP, 2018). Children are particularly susceptible to the negative impacts of food insecurity, because their brains and bodies are still developing (IOM, 2000).

	Kentucky	U.S.
Total Poverty	**17.1%**	**13.4%**
Child Poverty	**22.1%**	**18.4%**
Food Insecurity	**14.7%**	**12.3%**

Because there is a strong link between early childhood poverty and childhood obesity (Lee, Andrew, Gebremariam, Lumeng, & Lee, 2014), socioeconomic status and factors are now acknowledged as a “fundamental” cause of chronic disease that affects both behavior and biology (Goodman, Slap, & Huang, 2003). Youth who experience early poverty (i.e., prior to age 2 years) are 2.3 times more likely to become obese by the time they are 15.5 years of age than youth who are not poor during this age range (Lee et al., 2014). Understanding the role that poverty plays in influencing obesity from birth and into adolescence can help identify policies and governmental programs that in turn can diminish the incidence of obesity at early ages (Lee et al., 2014). By extrapolation, a lower childhood obesity rate can reduce disease burden of obesity and chronic disease in future adult generations (Guo, Wu, Chumlea, & Roche, 2002).

Although the childhood obesity epidemic is a serious public health concern, it can be positively addressed by improving the nutritional content of food which children consume (Y. Wang & Lim, 2012). Recent studies indicate that 30% of school age-children in the U.S. are overweight, and 15% are obese (Y. Wang & Lim, 2012). With childhood obesity rates on the rise, youth in minority and low-income families are particularly vulnerable since these demographics show the

highest rates of obesity (Ogden et al., 2014). Important for this study, there is a large body of evidence indicating that healthy eating habits and regular physical activity can help people achieve and maintain good health, as well as reduce the risk of developing a chronic disease throughout life (Smith et al., 2011). As adolescents spend a significant amount of time in school, the World Health Organization identifies the school environment as an ideal setting for youth to acquire nutritional knowledge and promote the consumption of fruits and vegetables by increasing the availability of healthy foods in schools (WHO, 2016).

National School Lunch Program

The National School Lunch Program (NSLP) is a federally assisted meal program which operates in public and nonprofit private schools, as well as residential child care facilities (C. J. P. Byker, Pinard, Yaroch, & Serrano, 2013). The NSLP was established in 1946 by the United States Department of Agriculture (USDA) (USDA, 2017). Each school day, the NSLP provides nutritionally balanced, low cost or no cost lunches to children, where participants consume approximately 40% of their daily caloric intake (Briefel, Crepinsek, Cabili, Wilson, & Gleason, 2009). Currently, the NSLP serves more than 30 million students each day in over 100,000 schools nationwide (USDA, 2017). In Kentucky, the NSLP is coordinated through the Kentucky Department of Agriculture's Division of Food Distribution. Presently, 1,388 schools in Kentucky participate in the NSLP, supplying over 150 million meals every year to Kentucky students (Kentucky Department of Ag., 2020). While these schools are required to serve nutritious foods which meet NSLP guidelines, many students make less than optimal food choices. Nearly half of Kentucky children (49.7%) consume fruits less than once daily, well below the 1½ to 2 cups daily recommended by USDA MyPlate (USDA, 2013b).

However, changing a student's health behaviors, like diet and physical activity, is difficult. Although focusing on individual health behaviors plays an important role in health promotion and disease prevention, there are many other factors that

influence behaviors. Since Kentucky children live and learn within multiple overlapping contexts, these variables include, but are not limited to household income; neighborhood environment; family, school, and social activities; and religious communities. For example, we know that children who live in lower socioeconomic status homes or poor neighborhoods have a 30–60 percent higher chance of becoming obese or overweight than those children living in better conditions (Singh, Siahpush, & Kogan, 2010). In order to promote a healthier lifestyle for all Kentucky youth, it is therefore necessary to identify and investigate the systems and policies that influence the ability of youth to make healthy choices.

Policy, Systems, and Environmental Changes

Policy, systems, and environmental (PSE) change strategies transcend direct health education by focusing on the structures and procedures that influence individual health behaviors. Policy changes can include statutes made at either the state legislative or local community level. Policy change can be made by creating or changing a written statement of an organization to make a lasting impact on individuals within that association. These regulations could include schools requiring healthy food options for all students or a school policy that prohibits unhealthy food in school fundraising drives. Systematic changes involve transforming the processes within an organization. Such systems and policy changes often work concomitantly. Systems changes concentrate on shifting the organization's culture to ensure healthier practices. These are unwritten and ongoing organizational decisions that result in reaching large amounts of people. Examples in the school setting might include implementing the NSLP or Smarter Lunchrooms program across state school systems. Applying environmental changes also involve adjustments made to the physical school setting and atmosphere that influences students' selections and behaviors. Environmental changes focus on built environment, economic, social, normative, or message environments that are visual and observable. Instances of possible environmental changes to the school cafeteria might include the installation of

signage or the strategic placement of healthy and unhealthy food options in the cafeteria food line. Using PSE strategies can be a simple and affordable way to encourage students to choose healthy foods on their own, without coercion or compulsion (A. S. Hanks, Just, Smith, & Wansink, 2012).

Smarter Lunchrooms Movement

The Smarter Lunchrooms Movement was developed by the Center for Behavioral Economics and Child Nutrition Program (The BEN Center) at Cornell University, with funding from the U.S. Department of Agriculture (USDA) (Cornell BEN Center, 2013). More than 29,000 U.S. public schools have implemented Smarter Lunchrooms principles and strategies since the program was launched in 2010 (Cornell BEN center, 2013). The BEN Center has conducted multiple research projects to encourage students to make healthier selections by focusing on the students' decision-making processes in school cafeterias. Overall, the BEN Center has found that the enhanced built environment plays a major role in youth decision making. Subsequently, it identified six smarter lunchroom principles that have persuaded students to select healthier food items. Those principles are: manage portion sizes, increase convenience, improve visibility, enhance taste expectations, utilize suggestive selling, and set smart pricing strategies (A. S. P. Hanks, Just, & Wansink, 2013).

The Smarter Lunchroom principles can be reduced to four basic components; convenience, variety, appeal, and verbal prompts (A. S. P. Hanks et al., 2013). The application of these principles can entail moving the location where fruits and vegetables are served in the cafeteria to the front of the line, offering multiple options of fruits and vegetables, and slicing fruit to increase the convenience of the food for adolescents. Additionally, cafeterias that implement the Smarter Lunchroom strategies are able to influence students' choices by creatively naming vegetable dishes and training food service staff in verbal prompts that create a cultural norm of consuming fruits or vegetables (Schwartz, 2007). The ultimate goal is singular and simple: to create an environment that leads students to make healthy food choices (A. S. Hanks et al., 2012). In turn, students

increase their consumption of fruits and vegetables. According to the USDA, Smarter Lunchroom strategies, such as how foods are named and where they are placed in the cafeteria, can facilitate healthy choices and increase fruit and vegetable consumption up to 70% (Cornell BEN center, 2013).

Importance of Study

A distributing increase in obesity rates from 2000 – 2016 has been observed in both adults and youth (Hales et al., 2017). While childhood obesity remains a major threat to public health in the United States, school-based approaches utilizing policy, systems, and environmental strategies are needed to address the multiple factors driving childhood obesity. Since childhood obesity is a complex health issue linked to both sedentary lifestyles and dietary patterns, the consumption of fruits and vegetables is indispensable to decreasing this trend (Nicklas & Johnson, 2004). Working with school cafeteria staff to implement the KYNEP Smarter Lunchrooms Pilot offers an opportunity for PSE change to directly impact students' current health, as well as future lifestyle choices. The purpose of Kentucky's Nutrition Education Program's (KYNEP) Smarter Lunchrooms Pilot Plate Waste Project is to implement Smarter Lunchroom strategies in Kentucky middle schools (grades 6-8) and thereby determine evidentially whether these interventions positively influenced students' selection of fruits and vegetables and decreased waste.

While the NSLP already has regulations in place to ensure that Kentucky schools serve nutritious foods, getting students to select and consume fruits and vegetables is another matter. By adjusting school cafeteria policies and systems, as well as intentionally designing the built environment to educate and encourage fruit and vegetable consumption, individual student behavior can be positively affected among school age youth. Research evidence demonstrates that school policies modified to enhance the school food environment leads to improvements in the purchasing behavior of children, which in turn results in higher dietary quality of the food consumed during the school day (Jaime & Lock, 2009). This simple strategy not only promotes a lifetime of healthier choices, but it also

impacts academic achievement in real time. “Helping students stay healthy through eating healthy foods and being physically active can help school districts achieve better overall test scores, grades, and attendance rates” (CDC Publication, Health and Academic Achievement).

Throughout the KYNEP Smarter Lunchrooms Pilot study, the local County FCS Agent provided the school cafeteria with marketing items designed to increase consumption of fruits and vegetables by middle school students. Training was provided to FCS agents with the aim of empowering them to build healthy school partnerships in order to construct PSE changes within each participating county middle school. Environmental changes like banners, food line setup, and signage were used in participating cafeterias for a six-week intervention. During the course of the pilot program, FCS Agents and School Food Service Staff supported personal and environmental changes to motivate students to make both easier and healthier food choices.

Specific Aims

The purpose of this observational research project is to examine the influence of the KYNEP Smarter Lunchrooms Pilot Plate Waste Project interventions on students’ fruit and vegetable purchases and food waste. Specific objectives of this study are:

Aim 1 a. of this study is to determine the impact of intervention on fruit and vegetable purchases.

Aim 1 b. of this study is to determine the impact of this intervention on fruit and vegetable waste.

Aim 2 of this study is to determine if the impact identified in aim 1 varied by interventions selected at each setting.

Hypothesis

1. After six weeks of the KYNEP Smarter Lunchrooms Pilot Plate Waste Project intervention, participating Kentucky schools' students will increase their purchases of fruits and vegetables.
2. After six weeks of the KYNEP Smarter Lunchrooms Pilot Plate Waste Project intervention, participating Kentucky schools' students will reduce their fruit and vegetable waste.
3. After six weeks of the KYNEP Smarter Lunchrooms Pilot Plate Waste Project intervention, participating Kentucky schools' selected intervention implementation will impact purchasing and influence waste.

CHAPTER 2

LITERATURE REVIEW

Childhood Obesity

Childhood obesity has been an increasing public health concern in the United States, especially in rural areas. Nearly one in three children in the United States are overweight or obese (Cawley, 2010). Childhood obesity is defined by determining whether a child ranks above the normal and healthy weight for their age and height i.e., equal to or greater than the 9th percentile (Ogden et al., 2014). Childhood is a critical period of growth and development since it lays the foundation for future physical, emotional, social, and cognitive health. In addition, obese children face an increased risk for chronic disease, a higher absentee rate in school, and lower academic performances than peers who maintain a healthy weight status (Geier et al., 2007; McGuire, 2012). Furthermore, estimates predict that the current population of obese children will indirectly cost the U. S. economy $208-$254 billion dollars from 2020 to 2050 due to medical expenses based on their condition (Hammond & Levine, 2010).

The high prevalence of childhood obesity concerns public health experts because of obesity's long-term negative health effects on an adolescent's development and lifelong health status (Ogden et al., 2014). Children who are overweight or obese have a 40%–80% chance of becoming overweight or obese adults and will therefore, suffer with long-term health consequences (Boyer et al., 2015; Umer et al., 2017). Adult obesity is associated with several serious health conditions; including heart disease, diabetes, metabolic syndrome, and cancer (Ramírez-Vélez et al., 2019). An overweight or obese child is at risk for many obesity-related illnesses such as abnormal blood pressure, dyslipidemia, fatty liver disease, pre-diabetes, polycystic ovary syndrome, obstructive sleep apnea, and psychological problems (Tyson & Frank, 2018). In addition, children and adolescents who are obese have lower self-esteem, higher rates of depression,

negative body image, a low self-reported quality of life compared to their non-obese peers, and often are victims of bullying (Danielsen et al., 2012; Tyson & Frank, 2018). In one study, 70% of obese children had at least one cardiovascular disease risk factor, while 39% had two or more (Umer et al., 2017).

The Department of Health and Human Services (DHHS) identifies the following behaviors which contribute to excess weight gain: eating high-calorie, low-nutrient foods and beverages, not getting enough physical activity, sedentary activities such as watching television or other screen devices, medication use, and sleep routines (USHHS, 2018). Early childhood has been identified as a critical period for obesity prevention based on how the development of early behavior patterns related to health can contribute to obesity, as well as the growing influence environmental factors (e.g., portion size, marketing) have on children's actions (Brotman et al., 2012). In addition, studies have shown that obesity at a younger age is an easier condition to reverse than adult obesity, suggesting that interventions to prevent childhood and adolescent obesity offer vital prospects for reducing the burden of chronic disease in America (Freedman et al., 2003; Lee et al., 2014; O'Brien et al., 2007).

Dietary and physical activity behaviors during adolescence not only influence cognitive outcomes (Tandon et al., 2016), but they also foretell future risk for chronic diseases (Weihrauch-Blüher, Schwarz, & Klusmann, 2019). Consistent moderate to vigorous physical activity for youth can reduce metabolic risk factors for obesity, as well as prevent numerous health conditions (Madsen, Hicks, & Thompson, 2011; Tyson & Frank, 2018). The 2018 U.S. Physical Activity Guidelines for Americans recommend that children and adolescents aged 6 to 17 years should have 60 minutes (1 hour) or more of physical activity each day (USHHS, 2018). Unfortunately, many children and adolescents do not meet these standards set forth in the Physical Activity Guidelines for Americans. Currently, Kentucky is the least- healthy state with 32.4% of adults reporting in

the past 30 days no physical activity or exercise other than their regular job (BRFSS, 2018).

In addition, most U.S. children do not meet national recommendations for fruit and vegetable servings (Moore, Thompson, & Demissie, 2017). Nearly half of Kentucky children (49.7%) consume fruits less than once daily, well below the 1½ to 2 cups daily recommended by USDA MyPlate (BRFSS,2018). To improve the wellbeing of Kentucky youth, healthy weight management strategies and education should begin as early as possible to help adolescents develop healthy lifestyle habits (Brotman et al., 2012; Tyson & Frank, 2018). Research shows that replacing foods of high energy density (high calories per weight of food) with foods of lower energy density, such as fruits and vegetables, can be an important part of a weight-management strategy (Tohill, Seymour, Serdula, Kettel-Khan, & Rolls, 2004).

The National School Lunch Program

The school cafeteria is a critical environment that influences food selection, consumption, and healthy eating. The National School Lunch Program (NSLP) is a federally assisted meal program operating in public and nonprofit private schools and residential childcare institutions (USDA, 2017). It provides nutritionally balanced, low-cost, or no-cost lunches to children each school day (USDA, 2017). The program was established under the Richard B. Russell National School Lunch Act, signed into law by President Harry Truman in 1946 (USDA, 2017).

In 2016, approximately 30.4 million children participated in the National School Lunch Program (USDA,2017). In 2010, the Healthy, Hunger-Free Kids Act (HHFKA) required that all students be offered fruit, dark green and red/orange vegetables, low-fat milk, and whole grains, and that all reimbursable meals include at least 3 items, including a fruit or vegetable (Marcason, 2012). The HHFKA changed the nutritional requirements for the NSLP to reflect the recommendations for the 2010 Dietary Guidelines for Americans and to enhance

the diet of school children to help combat the high rate of childhood obesity found in the United States (C. J. Byker, Farris, Marcenelle, Davis, & Serrano, 2014; Marcason, 2012). However, since HHFKA implementation, concerns arose that students were not consuming enough of the foods offered under the new requirements (Daily Journal of the US Government, 2010). Because researchers have found that the HHFKA new requirements have led to excess food waste, as well as reduced participation in the NSLP, and thus remain unsuccessful in accomplishing the USDA's overall goal of improving students' diets remain unfulfilled (Mitka, 2012).

Besides food offered by the NSLP, students have access throughout the day to competitive foods and beverages sold in vending machines, school cantinas, or fundraisers, where students can purchase food items (C. J. Byker et al., 2014). Competitive foods can include sweet snacks, salty snacks, or sugar-sweetened beverages (Marlette, Templeton, & Panemangalore, 2005). Such foods are not only low nutrient and energy-dense, but their availability is also influenced by contracts between schools and food and beverage companies (Briefel et al., 2009). Consequently, school lunchtime can be an effective setting for providing instruction and environmental changes to encourage healthier eating patterns (Mobley et al., 2012). Children consume, moreover, 35% to 47% of their daily dietary intake while at school (Briefel et al., 2009). Therefore, changes in the nutritional quality of foods and beverages served in NSLP schools, or via a la carte venues, can be part of the effort to decrease childhood obesity (Mobley et al., 2012).

The USDA "Smart Snacks in Schools" policy, as authorized by the HHFKA, was established to set nutrition standards for non-NSLP items sold in schools during the school day (also known as "competitive foods and beverages") (Asada, Chriqui, Chavez, Odoms-Young, & Handler, 2016). Smart Snacks in Schools calls for all foods and beverages sold on school grounds to meet the nutritional guidelines as required under the NSLP (Asada et al., 2016). However, in the 2014 school year, 87% of high school students nationwide still

had access to sugar-sweetened beverages through snack venues (Johnston et al., 2014), many schools are reluctant to remove all competitive foods since that revenue provides funding to support operational costs and school programs (Guthrie et al., 2012).

As schools nationwide work toward full implementation of Smart Snacks, the improvements in quality foods and beverages offered will hopefully improve healthy options being selected and consumed. However, merely providing students with access to fruits and vegetables will not guarantee that fruit and vegetable consumption will occur. Nonetheless, environmental changes to the school environment have been proven effective in creating healthier eating patterns among students (Mobley et al., 2012). Therefore, schools need to focus on how they can create an environment that makes the healthy choice the easy choice (Frieden, 2010).

Policy, Systems, and Environmental Changes in Schools

Public health practitioners continuously emphasize how policy, systems, and environmental (PSE) changes are key strategies for population-level health improvements and disease prevention (Cawley, 2010). By making healthy choices the easiest and most convenient options, PSE interventions focus on initiatives with a greater population impact, rather than concentrating on individual interventions that have limited sustainability (Frieden, 2010). PSE change strategies are, therefore, useful in addressing chronic diseases and other complex health problems, such as obesity and diabetes (Brennan, Castro, Brownson, Claus, & Orleans, 2011). With obesity affecting approximately 12.5 million American youth, PSE interventions are critical to promote and support healthy behaviors (McGuire, 2012).

Childhood obesity is a complex health issue. Multiple factors influence whether children are healthy weight or above normal weight for their height and age. Obesity is an accumulation of individual behavior choices and genetics, but other contributing factors include the food and physical activity environment, as

well as food marketing and promotion influence weight status (National Heart & Blood, 2010). On average, a child obtains 35% to 47% of their food consumption at school (Briefel et al., 2009). This is why both the American Academy of Pediatrics and the Institute of Medicine have deemed PSE intervention in schools a top priority in the battle against childhood obesity (Fox, 2010; Jaime & Lock, 2009). However, evidence concerning the effectiveness of PSE interventions among school-aged children is disappointingly inadequate (Story, Nanney, & Schwartz, 2009).

Although schools have traditionally provided direct education on information and knowledge regarding health, these dedicated programs have shown little evidence of influencing long lasting healthy lifestyle behaviors (Geier et al., 2007). A frequently overlooked factor is one's environment. Individual behavior plays a major role in the onset of chronic diseases, but multiple levels of intervention are essential for changing behaviors and social norms at the population level (Brennan et al., 2011; Schmid, Pratt, & Howze, 1995). As a result, PSE interventions are a way of thinking about how to successfully improve an individual's health choices, as well as improving population health for Kentucky and the United States. Policy and environmental interventions focused in the school setting to improve childhood obesity can include, but are not limited to: establishing healthy food options in vending machines, adding a tax on unhealthy food options, passing policies to construct safe routes to school, creating training systems that align with policies, farm-to-school programs, as well as increasing the availability of fresh, healthy foods in schools (Brennan et al., 2011).

More and more research now recommends strategies that center on environmental approaches to improve physical activity levels and dietary habits, rather than strategies solely aimed at individual behavior change (Ogden et al., 2014). Although the number of recommended PSE intervention strategies continues to grow, limited guidance is available on how to implement those strategies in relation to childhood obesity (Brennan et al., 2011; Hammond &

Levine, 2010). Results from school-based health promotion projects, such as the 5-a-Day Power Plus Program and the Child and Adolescent Trial for Cardiovascular Health (CATCH), suggest that a combination of parent involvement, direct education, and PSE approaches addressing availability and marketing of fruits, vegetables, and low fat foods can be effective in producing dietary change (Luepker et al., 1996; Mary et al., 2000).

A systematic literature review found evidence that school based PSE interventions were effective in 18 locations (Jaime & Lock, 2009). Overall, these 18 successful PSE interventions included increasing nutritional food being offered and changing item pricing. Both of these tactics positively affected fruit and vegetable intake (Jaime & Lock, 2009). Regrettably, the researchers did not collect data regarding BMI in order to track changes in the obesity rates of study participants.

Middle school policy and environmental changes have the potential to improve health behavior by encouraging physical activity and nutritional diets to lower rates of childhood obesity (Sallis & Glanz, 2006). As we know, health related habits are formed early (Cohen, Brownell, & Felix, 1990; Pringle, Doi, Jindal-Snape, Jepson, & McAteer, 2018). Consequently, the middle school years are important for students developing their own healthy habits and routines (Cohen et al., 1990). The adolescent years offer, moreover, opportunities for behavior to be shaped in ways that help youth make proactive choices to improve their immediate health, as well as, longer term health outcomes (Pringle et al., 2018).

In a study over two years, twenty-four middle schools were randomly assigned to participate in either intervention or control groups (Sallis et al., 2003). Environmental, policy, and social marketing interventions related to nutrition involved: providing and marketing low-fat foods at all school food sources, including cafeteria breakfasts and lunches, a la carte sources, school stores, and bag lunches (Sallis et al., 2003). Unfortunately, after two years, there was no evidence that the school–environment interventions improved students' health

behaviors (Sallis et al., 2003). Researchers ran into multiple barriers and the most significant was financial obstacles within schools to reduce availability of popular high-fat food items (Sallis et al., 2003). Schools experienced financial risk when introducing new products, especially perishable fruits (Sallis et al., 2003).

With long-term goals of improving dietary quality and preventing obesity and type 2 diabetes in adolescents, researchers completed a 6-week pilot study in two middle schools each from California, North Carolina, and Texas (Cullen et al., 2007). This case study was focused on how thirteen different environmental and policy changes could influence food/beverage selections among middle school students (Cullen et al., 2007). Researchers focused on offering lower-fat entrees, increasing fresh fruits and vegetables, providing bottled water, altering vending machine items, and reducing portion sizes of snack chips and sweetened beverages (Cullen et al., 2007). Overall, the food service changes were successful, and all but one school saw substantial change in fruit and vegetable purchases (Cullen et al., 2007). However, vending machines were the biggest barrier due to company contracts and the sales of items funding school programs (Cullen et al., 2007). Implementing a longer study, while also measuring student food intake, would help assess the specific issues and potential lasting impact of food service changes to the students' dietary consumption aimed at decreasing disease risk (Cullen et al., 2007).

Another approach to changing public school nutrition policies and environments was the Healthy Options for Nutrition Environments in Schools (Healthy ONES) randomized study (Coleman, Shordon, Caparosa, Pomichowski, & Dzewaltowski, 2012). The Healthy ONES studied six elementary schools and two middles schools in Southern California San Diego County for three years where 100% of children receive free and reduced lunch rates (Coleman et al., 2012). Intervention schools focused on eliminating unhealthy foods and beverages from their campuses, developing nutrition services as the main source on campus for healthful eating, and encouraging school staff to model healthy

eating (Coleman et al., 2012). Different from previous studies, these researchers conducted a longitudinal assessment of height and weight among participants. When the study concluded, researchers found that healthy food items increased during lunch in the intervention schools, yet no changes in obesity rates across the study occurred in either the control or intervention schools (Coleman et al., 2012).

Another randomized study, the Cafeteria Power Plus project, examined whether a cafeteria-based intervention would increase the fruit and vegetable consumption of children in 26 different schools over two years (Perry et al., 2004). The intervention consisted of daily activities (increasing the availability, attractiveness, and encouragement for fruits and vegetables) and special events (kick-offs, samplings, challenge weeks, theater production, and finale meal)(Perry et al., 2004). The study found that students in the intervention schools significantly increased their total fruit intake due to verbal encouragement by food-service staff (Perry et al., 2004). These findings suggest that multicomponent projects are more powerful than just PSE changes made in the cafeteria.

The Teens Eating for Energy and Nutrition at School (TEENS) study was a multicomponent intervention that recommended four approaches to change health behavior among adolescents (Birnbaum, Lytle, Story, Perry, & Murray, 2016). To address multiple levels of influence, researchers organized four possible exposure groups: (1) control group, (2)school environment interventions only, (3) classroom plus environment interventions, and (4) peer leaders plus classroom plus environment interventions (Birnbaum et al., 2016). The results found that differences in exposure to TEENS intervention components correlated directly with differences in the scale of eating pattern changes during the study. The group that received the most intensive concentration of interventions (#4) showed the greatest improvements in fruit and vegetable consumption (Birnbaum et al., 2016). Although the students who were exposed to TEENS classroom and school environment interventions (#3) showed trends toward improvements in

consumption, the changes were not as statistically significant as those who had peer leaders (Birnbaum et al., 2016). Finally, students who were exposed only to TEENS school environment intervention had a decreased fruit and vegetable consumption (Birnbaum et al., 2016). Therefore, when schools implement PSE changes, a multilevel and multisector approach proves more successful.

While we know that the built environment and childhood obesity are linked, evidence is unclear in knowing whether PSE changes made in schools reduce rates of childhood obesity (Sallis & Glanz, 2006). Unfortunately, many of these studies provide little evidence for long-lasting effectiveness of PSE interventions on childhood obesity. Researchers found several barriers, but the two common obstacles were funding and time. School food service staff, teachers, and administrators have little space in their schedules to be trained, let alone implement PSE projects. However, if schools offer healthy foods, students are likely to eat more healthful food, which might in turn decrease high obesity rates.

Smarter Lunchroom Movement

The Smarter Lunchrooms Movement is an evidence-based intervention designed to improve child eating behavior by providing research tested tools and strategies to enhance school lunchrooms (SNAP, 2019). Launched in 2010 from the Cornell Center for Behavioral Economics in Child Nutrition Programs (B.E.N. Center), the Smarter Lunchrooms Movement now operates in schools across the United States. The Smarter Lunchroom approach supports modifications in the school lunchroom environment in order to make healthy choices “convenient, attractive, and normal” for students. As a result, school age children improve their dietary intake (SNAP, 2019). Importantly, Smarter Lunchroom principles are affordable for school nutrition programs since they include low- to no-cost interventions that focus on choice and decreasing food waste by creating an environment that encourages students to select fruits and vegetables (A. S. P. Hanks et al., 2013).

Examples of Smarter Lunchrooms strategies recommended by the USDA include (SNAP, 2019):

1. Offer fruit in at least two locations on the serving line, one of which is right before the point of sale.
2. Conduct vegetable taste tests.
3. Label pre-packaged salads or salad bar choices with creative, descriptive names and display them next to each choice.
4. Label fruits and vegetables with creative, descriptive names such as x-ray vision carrots or protein packed chickpeas.
5. Bundle a reimbursable meal into a grab-and-go option and label it with a creative name like the Hungry Kid Meal.

Around the world, researchers have confirmed that even small adjustments in a cafeteria environment can yield an increase in the healthy food choices made by students. The Cafeteria Power Plus program demonstrated that by both increasing the variety of fruits and vegetables available in the cafeteria and having food service staff verbally encourage students to try fruits and vegetables, consumption of both fruits and vegetables can increase (Perry et al., 2004). These results were replicated when another set of researchers found that a simple verbal prompt by food service workers in the lunch line, i.e., asking students if they wanted fruit or juice, led to increased purchase of fruits or fruit juices, as well as increased consumption (Schwartz, 2007). A study in Yorkshire, England, found that a set of small changes to the choice architecture over a 6-week period could also influence a student's food choice (Ensaff et al., 2015). Researchers who focused on designing a cafeteria environment that profiled designated food items (whole fruit, fruit salad, vegetarian daily specials, and sandwiches containing salad) found that selection of items significantly increased during the intervention and post-intervention periods (Ensaff et al., 2015).

Student were 2.5 times as likely to select the designated food items, compared to the baseline (Ensaff et al., 2015).

Interventions as simple as a verbal prompt can have a significant effect on whether students will take, and consume, more fruits and vegetables with their purchased school lunch. A pilot study conducted by Schwartz evaluated the effectiveness of the verbal prompt, *"Would you like fruit or juice with your lunch?"*, on the consumption of fruit in NSLP elementary schools (Schwartz, 2007). Approximately 90% of students in the verbal intervention school took a fruit serving, while only 60% of students in the control school did (Schwartz, 2007). Moreover, the fruit consumption rate for the intervention school students was 70%, compared to less than 40% for the control group (Schwartz, 2007). In addition, a study completed in 2004 also determined that verbal prompts and interventions increased the consumption of fruits and vegetables among students (Perry et al., 2004).

In 2016, the Iowa Team Nutrition worked with the University of Iowa (UI) to guide 5 high schools through a process using the Smarter Lunchroom in order to make environmental changes to their cafeterias (Delger, Scheidel, & Askelson, 2016). A significant difference was found when students were included in the decision-making process. Therefore, the inclusion of student input and buy-in in the Smarter Lunchroom process is another key factor in achieving successful behavior change (Delger et al., 2016).

A study conducted by Hakim & Meissen utilized the "offer" model to reduce food waste. This strategy allowed students to have an active choice by selecting the foods that they preferred. The "choices" cafeteria intervention produced an average daily increase of 15% of fruits and 15.6% of vegetables consumed as part of the NSLP (Hakim & Meissen, 2013). These results suggest that setting-level interventions, such as the one used in this study, can have a measurable impact on the effectiveness of the NSLP (Hakim & Meissen, 2013).

As the above research demonstrates, Smarter Lunchroom tactics are effective in the school lunchroom setting. By implementing the Smarter Lunchroom principles, the potential for an increase in the consumption of fruits and vegetables and a decrease in high calorie snack consumption is significant. By increasing the availability and convenience of fruits and vegetables, as well as having food service staff give verbal cues for healthy food items, students' nutritional consumption can rise (A. S. Hanks et al., 2012; Perry et al., 2004). Most important for this study, if better food choices are consistently and regularly made by students, obesity rates and the development of subsequent chronic diseases could be lowered dramatically.

CHAPTER 3

METHODOLOGY

The purpose of this pilot study is to implement Smarter Lunchroom strategies in three participating Kentucky middle schools and then assess two outcomes: (1) determine the impact of the intervention on fruit and vegetable purchases and waste, and (2) determine how purchases or waste varied by interventions selected for each setting.

Collaborative Approach:

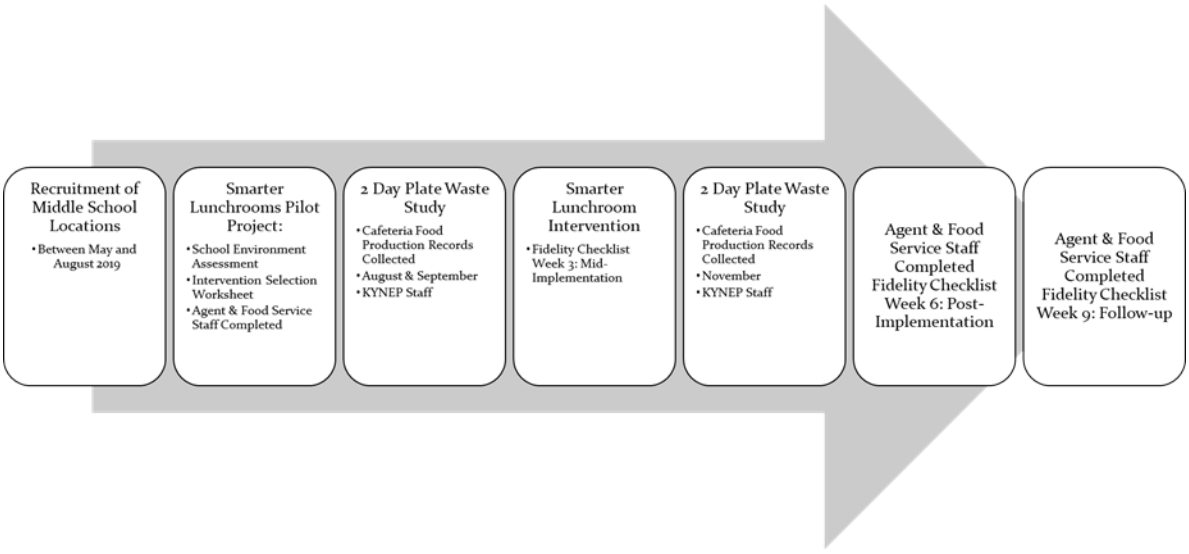
The KYNEP encompasses two separate USDA programs: The Expanded Food and Nutrition Education Program (EFNEP) and the Supplemental Nutrition Assistance Program (SNAP-Ed) (KYNEP, 2018). Both programs are administered by the University of Kentucky Cooperative Extension Service and target low-income families and individuals with intentional nutrition education (KYNEP, 2018). The goals of both initiatives are to educate both limited resource families with young children and SNAP eligible individuals in how to plan nutritious meals on a limited budget, acquire safe food handling practices, improve food preparation skills, and change behavior necessary to achieve a healthy lifestyle (KYNEP, 2018). Funding for this project is provided by the KYNEP, which in turn obtained permission from the Kentucky Board of Education (BOE). In January of 2019, a meeting with the Superintendent and the Board of Education from each individual school district was held to explain the project and timeline. In addition, KYNEP partnered with the University of Kentucky Cooperative Extension Family and Consumer Sciences (FCS) Cooperative Agents, whose primary responsibility is to improve the quality of individual and family life through education, research, and outreach (UKFCS, 2020).

Training of Cooperative Extension Family and Consumer Science Agents

The University of Kentucky FCS Agents were invited in May 2019 to attend Smarter Lunchroom Training, hosted by KYNEP researchers trained in

behavioral economics and the six principles of Smarter Lunchrooms. All three FCS Agents participating in the pilot plate waste study attended the one-day training session consisting of Smarter Lunchrooms theories, strategies, and evaluation. The training also included materials for recruitment of schools, as well as clear roles and responsibilities to support the schools' food service staff during the intervention.

KYNEP Smarter Lunchroom Pilot Project Overview



Recruitment of Middle School Locations for Pilot Study

Each of the three trained UK FCS Agents recruited one middle school from their respective county to participate in the KYNEP Smarter Lunchroom Plate Waste Project. The recruitment period was between May and August 2019 and was followed by the 6-week intervention period. Inclusion criteria for each school consisted of serving middle school students (6th through 8th grades) and participating in the NSLP. During the recruitment phase, FCS Agents scheduled meetings with both the school administrators and school food service staff to secure participation in the study and obtain a signed letter of support. Once this phase was completed, relationships were created with the Food Service Director of the different counties, as well as the schools' principals and cafeteria staff. The next step was to establish a pre-intervention assessment. As an incentive, marketing materials were provided to each participating school.

Demographic Characteristics of Participating Schools in three Kentucky Schools, 2019

Demographic Characteristics	School 1	School 2	School 3	Total Reach
Total enrollment grades 6 -8 (n = students)	474	542	970	1, 986
Average NSLP (% students)	66%	100%	50%	72%

Assessment and Intervention

During Fall 2019, marketing materials were provided to each participating school by the Cooperative Extension Service at no charge to the school. Items included wall banners, cafeteria aprons, and signage for the cafeteria serving line. FCS Agents also worked with the school food service staff 2-3 weeks prior to starting the intervention in order to complete the School Environment Assessment form measuring their assets, strengths, and needs, as well as to develop action steps for policy, systems, and environmental changes.

Using the results from the School Environment Assessment form, participating school food service staff completed the Intervention Selection Worksheet (with assistance/guidance from the FCS agent) and selected Smarter Lunchrooms strategies which would be most appropriate for their cafeteria. After both the School Environment Assessment form and Intervention Selection Worksheet were completed, each participating school identified a feasible 6-week time period. All interventions were completed during the fall 2019 semester.

Cafeteria Daily Production Records and Food Usage Worksheets were collected before, during, and after the project implementation. Because these are the same forms that are already submitted to KDE Nutrition Branch, no extra burden was placed on the food service staff. Furthermore, neither individual students nor classrooms were identified. In addition, representatives from the Kentucky

Department of Education School Nutrition Branch were involved in the structure of this project. Finally, the data was collected to determine the effectiveness of each school's selected Smarter Lunchrooms strategy intervention.

Measures and Data Collection

Plate Waste

As part of the KYNEP Smarter Lunchrooms Plate Waste Study, a pre-post prospective study design was used prior to (week 1) and after implementing lunchroom policy, systems, and environmental changes (week 6). The KYNEP research team plate waste study was executed on two consecutive days in August 2019 before implementation of the Smarter Lunchroom strategies. The team returned on two consecutive days in November 2019, approximately 6 weeks after strategies had been applied. In total, there were four plate waste collection days at each participating location. The same two lunch menus were served to students during the repeat pre and post intervention plate waste study.

Plate waste was calculated by weighing each fruit and vegetable in pounds. All disposable items such as napkins, straws, and food wrappers were disposed by KYNEP researchers. The fruit and vegetable waste was collected from all trays when the students finished eating. Students were instructed to leave their trays and all waste on the table. The waste was sorted into individual bins and weighed before being deposited in normal lunchroom trash bins. Lunchroom food production records were collected after each day to determine what was being purchased and what was being wasted. Food production records included: the number of meals served, the type of food served, the amount prepared, and the amount leftover.

Plate Waste Data Collection Schedule

	PRE SML Intervention	**POST SML Intervention**
School 1	9/17/2019 & 9/18/2019	11/12/2019 & 11/13/2019

School 2	8/19/2019 & 8/20/2019	11/19/2019 & 11/20/2019
School 3	9/23/2019 & 9/24/2019	11/25/2019 & 11/26/2019

Lunchroom Food Records and Fidelity Checklist

Each participating middle school in the pilot study turned over their lunchroom records after each plate waste collection day, in order to identify total servings of fruits and vegetables purchased. A pre-post prospective study design will be used to compare fruit and vegetable purchasing prior to and after implementing lunchroom policy, systems, and environmental changes.

The fidelity checklist was filled out on Weeks 3, 6, and 9 in order to verify the extent to which the elements of the selected intervention wave implemented. Food service staff completed the following forms with assistance from their FCS County Agent:

1. UK Nutrition Education Program's Smarter Lunchrooms Project School Environment Assessment
2. Intervention Selection Worksheet
3. Week 3: Mid-Implementation Fidelity Checklist
4. Week 6: Post- Implementation Fidelity Checklist
5. Week 9: Follow- Up Fidelity Checklist.

Statistical Analyses

Aim 1a: A paired T-test was used to compare mean scores for the purchase of fruits and vegetables at each school, by utilizing purchase records of the pre and post intervention (hypothesis 1a). Our alpha was set at .05.

Aim 1b: Descriptive analysis was calculated by summing the total amount of pounds of fruit and vegetable servings per day. A paired T-test was conducted to

determine statistically significant changes from pre to post for each school (hypothesis 1b). Our alpha was set at .05.

Aim 2. Process evaluation analysis was performed by summarizing the fidelity checklist reports from weeks 3, 6, and 9 to evaluate the relationship between interventions selected at each site on the impact of purchase and on fruit and vegetable waste variation.

Evaluation Timeline:

1. Fidelity Checklist Week 3: Mid- Implementation
2. Fidelity Checklist Week 6: Post – Implementation
3. Fidelity Checklist Week 9: Follow- Up

Institutional Review Board: Submitted IRB and Not Human Research (NHR) Determination Form

The University of Kentucky Institutional Review Board (IRB) was consulted for this project and subsequently approved the study. Its response follows:

“On August 21, 2019, the Institutional Review Board (IRB) Chair or designee reviewed your attached NHR request form. Based on the information provided by you in the form, it was determined that your project does not require IRB review because it does not appear you will be doing research about a living individual, but about fruit and vegetable food waste in schools. So long as you are not collecting any information about the children leaving the food waste on their meal trays, your proposed activity does not meet the federal definition of human subject; “a living individual about whom an investigator conducting research obtains (i) information or biospecimens through intervention or interaction with the individual and uses, studies, or analyzes the information or biospecimens; or (ii) obtains, uses, studies, analyzes, or generates identifiable private information or identifiable biospecimens.” [45 CFR 46.102(e)(1)]. Although your project does not require IRB review, please contact the Office of Research Integrity before

making any changes to your project because some changes may make the project eligible for IRB review.”

CHAPTER 4

RESULTS

The purpose of this study was to evaluate the Kentucky Nutrition Education Program's (KYNEP) Smarter Lunchrooms Pilot Plate Waste Project by implementing Smarter Lunchroom strategies in Kentucky middle schools (grades 6-8) and then determining whether these interventions positively influenced students' selection of fruits and vegetables and subsequently decreased waste. All three participating schools submitted complete sets of data (i.e., Environment Assessment, Intervention Selection Worksheet, Mid-Implementation Fidelity Checklist, Post- Implementation Fidelity Checklist, Follow- Up Fidelity Checklist, and pre- and post-food production records). The evaluation of the study's findings occurs in five steps: first, it offers the relevant demographics of the participating schools; second, it presents the findings of each school's interventions vis-a-vis two particular aims; third, it identifies the specific intervention elements employed by each participating school; fourth, it provides a descriptive analysis of the status updates for each school; and fifth, it reviews the study's findings via a summary. All data was analyzed using IBM SPSS Statistics 27 software. Our alpha was set at .05.

Demographics

Health is influenced not only by individual behavior but also where one lives. Table 1 illuminates the differences in prospects for health in the three Kentucky counties with a school participating in this study, compared to data available for Kentucky as a whole. According to County Health Rankings, 22% of Kentucky children are living in poverty, higher than the national average of 18% (2020, County Health Rankings). Because child poverty serves as a predictor of present and future chances of health in a county, addressing the importance of a healthy childhood ensures a healthy future for not only individuals but also for communities.

Table 1. Specific County Demographic Characteristics of Participating Schools in three Kentucky Schools, 2019.

Demographic Characteristics	School 1 County	School 2 County	School 3 County	Kentucky
Population	13,345	14,529	26,533	4,469,402
% Non-Hispanic White	92.6%	96.0%	85.9%	84.3%
% Rural	100%	100%	36.2%	41.6%
Poor or fair health	26%	19%	18%	24%
Diabetes Prevalence	17%	14%	13%	17%
Adult Obesity	38%	33%	32%	34%
Median Household Income	$38,800	$54,600	$66,200	$50,200
High School Graduation	93%	95%	97%	90%
Some College	43%	46%	64%	62%
Unemployment	6.3%	4.1%	3.1%	4.3%
Children in Poverty	32%	23%	13%	22%
Children Eligible for NSLP	71%	62%	47%	60%
Health Behavior County Rankings (out of 120 KY Counties)	96	46	3	

Source: University of Wisconsin Population Health Institute. County Health Rankings State Report 2020.

Table 2 displays each participating school's enrollment and percent of students' utilizing the NSLP. All three participating schools reported that 50 percent or more of their students were eligible for free or reduced-price lunches. School 2 reported 100 percent student eligibility.

Table 2. Demographic Characteristics of Participating Schools in three Kentucky Schools, 2019.

Demographic Characteristics	School 1	School 2	School 3	Total Reach
Total enrollment grades 6 -8 (n = students)	474	542	970	1, 986
Average NSLP (% students)	66%	100%	50%	72%

Interventions

Aim 1a: Changes in Number of Fruit and Vegetable Servings Purchased

The number of fruits and vegetables servings purchased per day at pre- and post-intervention was determined by the food production records provided from the schools using a paired sample t-test. Results are presented in Table 3. Contrary to the hypothesis, fruit and vegetable purchases decreased by 3.71% between pre- and post-intervention. Findings are statistically insignificant due to a *p* value greater than 0.05.

Table 3. Pre and post intervention fruit and vegetable purchases per day in three middle schools in Kentucky (combined), 2019.

	Pre-value (mean)	Post-value (mean)	Descriptive Statistics % Change	*p* value[a]
Purchases (servings served)	139.84	134.65	-3.71 %	*0.455*

[a] $p<0.05$

Aim 1b: Changes in Fruit and Vegetable Waste

Plate waste was calculated by KYNEP researchers who weighed each fruit and vegetable in pounds using a Rubbermaid Commercial Products FG401088 Digital Food Service Receiving Scale, 150 lb. Plate waste was determined by using a paired sample t-test. Results are presented in Table 4. Overall, there was a 10.1% decrease in pre- and post-intervention fruit and vegetable waste of all three middle schools combined. However, findings are statistically insignificant due to a *p* value greater than 0.05.

Table 4. Pre and post intervention fruit and vegetable waste in pounds (lbs.) of three middle schools in Kentucky (combined), 2019.

	Pre-value (mean)	Post-value (mean)	Descriptive Statistics % Change	*p* value[a]

Waste (lbs.)	8.0507	7.2377	-10.1 %	*0.310*

[a] p<0.05

Aim 1 a and b: Changes in Fruit and Vegetable Purchases and Waste

The number of fruit and vegetable servings purchased, determined by the food production records provided by the schools and subsequent waste at pre- and post-intervention, was stratified by each school and significant pre-post differences were determined by using a paired sample t-test. Results are presented in Table 5. Increases in the number of servings purchased were observed for all the locations. However, there were no statistically significant increases in the number of fruit and vegetable servings purchased after the intervention. Two of the three schools displayed decreases in plate waste. However, only one school, School 3, showed a significant decrease (p<0.05) in plate waste after the intervention (p=0.023). However, sizeable changes in purchases and plate waste did take place in School 2. This school was able to increase fruit and vegetable purchases by 8.62%, while simultaneously decreasing plate waste by 26.83%.

Table 5. Fruit and vegetable purchases and waste, stratified by school, pre and post interventions, in three middle schools in Kentucky, 2019.

	PURCHASES [b]				WASTE [c]			
	Pre-value	Post-value	Descriptive Statistics % Change	*p* value [a]	Pre-value	Post-value	Descriptive Statistics % Change	*p* value [a]
School 1	120.8889	125.1111	3.49 %	0.665	9.2545	9.5636	3.34%	*0.814*
School 2	160.4167	174.2500	8.62 %	0.548	4.1995	3.0727	-26.83 %	*0.082*
School 3	164.2632	156.6316	-4.65 %	0.768	5.8900	4.8140	-18.27 %	***0.023***

[a] p<0.05

[b] number of F&V servings purchased

[c] Waste in pounds (lbs.) of F&V item

Aim 2: Impact identified in aim 1 varied by interventions selected at each setting

Schools were asked to complete the School Environment Assessment form to determine the cafeteria environmental conditions and extent of nutrition related policy, systems, and environmental (PSE) strategies in a given school before implementation of the KYNEP Smarter Lunchrooms Pilot Plate Waste Project. Table 6 summarizes the number of PSE fruit and vegetable strategies practiced in each participating school lunchroom, as well as strategies not practiced before the study.

Table 6. School environment assessment of number of fruit and vegetable PSE strategies implemented and not implemented, stratified by school, descriptive analysis prior to intervention, in three middle schools in Kentucky, 2019.

	Fruit and Vegetable Strategies Implemented	**Fruit and Vegetable Strategies <u>Not</u> Implemented**
School 1	27	18
School 2	25	20
School 3	33	12

*Max score = 45

Intervention Elements

Initially, schools were asked to use the completed School Environment Assessment form when selecting an intervention from the Intervention Selection Worksheet. Then, schools were instructed to select one out of eleven interventions that best fit their school's cafeteria needs. Table 7 summarizes the descriptive characteristics of intervention elements selected for implementation by each participating middle school.

Table 7. Description of Smarter Lunchroom intervention selected by three middle schools in Kentucky, stratified by school, 2019.

	Intervention Selected	**Description of Intervention Elements**
School 1	General Fruit promoting changes	1. Fruit is placed first on the line. 2. Serve (offer) at least 2 kinds/varieties of fruits. 3. Fruit is offered in at least two separate locations/lines. 4. Cut fruits are displayed in small, attractive cups. 5. Whole fruits are displayed in a large, attractive fruit bowl at eye level. 6. Fruits are labeled with creative names. 7. Creative fruit names are displayed on monthly and daily menus.
	General Vegetable promoting changes	1. Vegetable/salad is placed first on the line. 2. At least two varieties of vegetables are offered. 3. Vegetables are offered in at least two separate locations/lines. 4. Salads/cut fresh veggies are displayed in small, attractive cups. 5. Whole fresh vegetables/ salads are displayed in a large, attractive bowl at eye level.
School 2	Vegetable Attractiveness	1. Lunch menu posted with nice color photos of vegetables served. 2. Vegetables/salads labeled with descriptive names.

		3. Fresh vegetables/salads displayed in nice bowls or tiered stands. 4. At least two kinds of vegetables on line.
School 3	Vegetable Nutrition messaging	1. Large dry erase boards with vegetable factoids easy to see. 2. New vegetables factoid on board each week – factoids are facts about specific vegetables. 3. Signs/boards with vegetable messages easy to see. 4. At least two kinds of vegetables on line.

Status Updates

To indicate the accuracy and consistency of implementation throughout the pilot study, all three Fidelity Checklists (i.e., Mid-Implementation, Post-Implementation, and Follow- Up), were used to determine the extent in which Smarter Lunchroom interventions were implemented throughout the study and provide descriptive analysis for each status update and aim 2. Descriptive analysis of the extent of intervention elements implemented at each participating school's cafeteria environment was combined using results from all three Fidelity Checklists and is presented in Table 8.

Table 8. Descriptive analysis of extent of selected Smarter Lunchroom intervention elements implemented, fidelity checklist at three status update points, mid-implementation, post implementation, and follow-up, stratified by school, in three middle schools in Kentucky, 2019.

	Status 1 *Mid-implementation*			**Status 2** *Post-implementation*			**Status 3** *Follow-Up*		
	Low	Medium	High	Low	Medium	High	Low	Medium	High

School 1	0	3	9	2	0	10	0	0	12
School 2	1	0	3	0	1	3	0	3	1
School 3	0	0	4	0	0	4	0	0	4

* Scale: Low = intervention elements not implemented, Medium = intervention elements partially implemented, and High = intervention elements fully implemented.

Specific aim 2 was based on the hypothesis that fruit and vegetable servings would increase, and plate waste would decrease as a result of the intervention selected and fidelity of intervention elements being fully implemented at status update point 2 (post-implementation) and status update point 3 (follow-up). School 1 had two interventions selected and each fidelity checklist status update included 12 element intervention scores. Schools 2 and 3 each had one intervention selected and each fidelity checklist status update included four element intervention scores. We hypothesized that the higher the overall school's fidelity score was, the more fruits and vegetables would be purchased, and less food waste would be produced. However, there was no statistically significant increase in fruit and vegetable purchases and only one school exhibited a decrease of plate waste. Alternatively, substantial but non-significant percentage changes in School 2 and 3 was detected, while both reported elements being fully implemented at status update point 2 (post-implementation). Yet, according to the fidelity checklists status update point 3 (follow-up), School 2 self-reported being unable to maintain intervention elements bring fully implemented. Consequently, fidelity of selected Smarter Lunchroom intervention elements implemented by school did not extrapolate statistical significance on purchasing nor waste.

Comments from the food service staff on the fidelity checklists suggested positive support of the project, as well as high maintenance of intervention elements implemented as the post-implementation and follow-up fidelity checklists scores indicated. Observations learned from the project and common themes obtained from the comments in the fidelity checklists helped identify the

settings and environmental factors that could have influenced interventions. The observations and comments are presented in Table 9. These observations/comments are both encouraging to and informative for KYNEP specialists when tailoring the KYNEP Smarter Lunchroom Project which will be distributed to more counties throughout the state of Kentucky.

Table 9. Descriptive analysis of provided observations/comments about the selected Smarter Lunchroom intervention elements implemented, fidelity checklist at three status update points, mid-implementation, post implementation, and follow-up, stratified by school, in three middle schools in Kentucky, 2019.

	Status 1 *Mid-implementation*	**Status 2** *Post-implementation*	**Status 3** *Follow-up*
School 1	"children loved the large clear fruit bowls" "did not change weekly, but periodically"	"the fruitastic bowl was a hit" "teachers like youth reading creative names and 'fun' jokes"	"fun ideas engaged students and cafeteria staff enjoyed too" "staff and students asked when UK would be coming back"
School 2	"working on additional ways to display" "hopefully will implement soon"	"All cafeteria employees super positive in trying to promote healthier eating habits. Enjoying trying new things."	"Part of the issue is space available on the serving line to display. They are very creative in the space available" "most labeled, some in color, some not"
School 3	*No observations/ comments provided*	"vegetable factoids were displayed on the barriers next to each vegetable being served"	"a comment from a food service employee was about this intervention probably not having any effect on students' choices….

			to make an impact would be more education, starting in the classroom, but also in the café, at evening school events, and throughout the school as a whole”

Summary

After examining fruit and vegetable purchasing practices from all schools, we found no statistical significant increases from pre to post intervention. Combined, we also found no statistical significant decreases in fruit and vegetable plate waste. When stratified by individual school, School 3 was the only participating school that showed a statistical significant change ($p = 0.023$) from pre to post intervention for fruit and vegetable plate waste. Stratified descriptive statistics exhibited a substantial change, with School 2 decreasing plate waste by 26.83% from pre to post intervention and slightly increasing fruit and vegetable purchases by 8.62 % from pre to post intervention. We can deduce from the descriptive statistics, that two out of the three participating schools are substantially decreasing plate waste and showing movement for increasing fruit and vegetable waste. As can be seen, substantial improvements in School 2 and School 3 took place throughout the 6-week pilot study. It can be concluded that a larger n and longer study duration is needed in order to increase magnitude of change and increase statistical significance.

CHAPTER 5

IMPLICATIONS FOR PUBLIC HEALTH

The main objective of this pilot study was to determine if the Kentucky Nutrition Education Program's (KYNEP) Smarter Lunchrooms Pilot Plate Waste Project positively influenced students' selection of fruits and vegetables and decreased waste. Results could determine whether UK KYNEP ought to expand the Smarter Lunchroom Program to include more than three Kentucky middle schools. The results of this pilot study could also inform how to tailor future approaches to address students' fruit and vegetable purchases and waste. Most important, these interventions should augment the successful implementation of PSE strategies in middle schools to reduce childhood obesity. This chapter presents the pilot study's findings and recommendations under six headings: conclusions, interventions, fidelity checklists, limitations, summary, and implications.

Conclusions

This was the first pilot study conducted to evaluate the process of implementing Smarter Lunchroom intervention elements in Kentucky schools. While it was a small study, it helped test the potential problem areas and deficiencies in research protocols, data collection, and sample recruitment strategies in preparation for a larger study. It also helped members of the research team become familiar with the procedures in the protocol and aid in deciding future study methods. This study suggests that small changes in cafeterias and lunchrooms can have a substantial influence on guiding students toward healthier behaviors. We are seeing a trend in our descriptive statistics toward increased purchases and decreased waste. Stratified descriptive statistics exhibited a substantial change, with School 2 decreasing plate waste by 26.83% from pre to post intervention. If School 2 can exhibit measurable changes after 6 weeks of implementing fruit and vegetable strategies, then it is possible that

Kentucky's NEP Smarter Lunchroom Project will also benefit other schools. This illustrates the magnitude of change made during the pilot study and future successes that Kentucky Middle Schools could have from participating in the Smarter Lunchroom Program. However, because we did not find combined statistical significance in both purchases and plate waste, the study's findings support tailoring approaches to address students' purchases and plate waste. Most important, these interventions should augment the successful implementation of PSE strategies to reduce childhood obesity in Kentucky middle school students.

Overall, implementation of the Smarter Lunchroom Movement Pilot led to a slight increase in fruit and vegetable purchases in two participating schools. However, significant increases in fruit and vegetable servings purchased after the intervention were not observed in any participating school. Moreover, implementation of the Smarter Lunchroom Movement Pilot Project combined did not significantly decrease fruit and vegetable plate waste. When stratified by school, one school showed a statistically significant change ($p = 0.023$) from pre to post intervention. This lack of statistical significance could be due to several factors: the experimental pilot design of the study, the limited number of participating schools, food service staff buy-in , school administrative support, FCS agent proficiency, and a narrowed focus by only observing a select few Smarter Lunchroom strategies in participating schools over a short duration (six weeks).

As a result of PSE change, schools can aid in reducing childhood obesity through nutrition messages and modifying the environment to make the healthy option easier. This study represents the first attempt by the Kentucky's Nutrition Education Program to use PSE and the Smarter Lunchrooms Project across the state of Kentucky. This proof of concept program advances the idea that environmental changes can motivate students to make both easier and healthier food choices. Although the goal was to recruit fifteen schools to implement KYNEP Smarter Lunchrooms Pilot Plate Waste Project, only three schools

participated. All participating schools submitted completed sets of food production records and fidelity checklists, as well as partook in a total of four plate waste data collection days. Rather than the expected increase in fruit and vegetable purchases, the descriptive analysis data reflects only a slight increase in two schools (School 1 +3.49% and School 2 +8.62%) and a small decrease in the other (School 3 -4.65%). These descriptive statistical percentage changes might be explained by the level of support given from the local FCS Agent to the food service staff, or willingness to participate and buy-in of school food service staff. Available space in the cafeteria and lunch lines also differed by school, making implementation of displaying fruit and vegetable options or nutrition messaging difficult for some participating schools.

Instead of the anticipated combined decrease in fruit and vegetable plate waste, when stratified by schools, the data reflects that only School 3 had a statistically significant change ($p = 0.023$) from pre to post intervention. This result might be explained by the timing of the intervention and exposure since School 3 implemented the most fruit and vegetable PSE strategies prior to intervention. Prior to the implementation of the KYNEP Smarter Lunchrooms Pilot Plate Waste Project, School 3 had implemented 33 nutrition related policy, systems, and environmental (PSE) strategies. Therefore, students at School 3 were already predisposed based on the school's deliberate environment that encouraged the consumption of more fruits and vegetables prior to the intervention. This intentional ethos could have also contributed to waste reduction. An alternative explanation for School 3 having significant chance could be due to their impressive Health Behavior Ranking of 3 out of 120 Kentucky counties. The academic community has widely accepted that behaviors are influenced by where you live, cultural norms, and economic conditions. When a child lives in a county that ranks higher for health factors, it is common for them to live in a household with more financial security and health literacy. Increasing exposure to a healthy lifestyle at home that trickles into the school and community. Predisposing students at School 3 to increase fruit and vegetable intake due to healthy lifestyles being modeled throughout the community. The

statistically significant changes the study found was in a county that already performed well in health factors and outcomes.

The purpose of the School Environment Assessment form was to determine the cafeterias' contextual conditions and extent of nutrition PSE strategies in each school before implementation of the KYNEP Smarter Lunchrooms Pilot Plate Waste Project. Based on the self-reported assessments, School 3 students prior to this project were already being influenced by more strategies than Schools 1 and 2. Prior to the study, Schools 1 and 2 lacked the resources to guide efforts that are needed for students to be healthier and to have healthy choices. An alternate explanation of the decrease in fruit and vegetable waste after implementation of the project in School 3 could be attributed to the decreased fruit and vegetable servings purchased post intervention.

Interventions

When comparing interventions selected by all three schools, this study explored if the school cafeteria environment of fruit and vegetable strategies tried, stratified by schools before and after implementing Smarter Lunchroom strategies, would impact (1) fruit and vegetable purchases and (2) fruit and vegetable waste. Overall, we found changes where counties were already doing well. However, the program must work where the need is the greatest. In order to decrease childhood obesity and increase health outcomes for communities, the Smarter Lunchroom intervention needs to work with those children who really need quality nutrition the most to close the health gaps between those with the most and least opportunities for good health. For some schools in Kentucky, the essential elements for a healthy choice are readily available; for others, the opportunities for healthy choices are significantly limited. For example, School 1 ranks 96th out of 120 Kentucky counties and has the highest risk factors of participating schools that increases the chances of students developing obesity. However, this study did not generate substantial descriptive statistics change or produce statistically significant data in School 1 where increasing health

outcomes among students is vital. Yet we did see statistical significance in School 3 where students are at a are at lower risk for developing obesity. To address the span of health factors in Table 1 of chapter 4; time, commitment, and making sustainable PSE changes in not only the education system but also within communities are required.

School 1 is located in our least healthy participating county. It had the smallest population (13,345 people) and only 474 students are enrolled in the county middle school. In addition, School 1 had the highest (almost double of School 3) unemployment rate, children in poverty, and median household income. Although School 1 showed the most room for improvement, we did not find statistically significant results. This school selected two interventions and self-reported that all 12 intervention elements were fully implemented at the time of the last status update. Subsequently, School 1 was able to increase fruit and vegetable purchases by 3.49% over the intervention timeline. Even though School 1's descriptive statistics showed a slight increase in the number of fruit and vegetable servings sold, it was not found to be significant. In addition, fruit and vegetable waste descriptive statistics showed a slight increase, instead of the anticipated decrease in plate waste. Percentage change for waste was 3.34%, indicating an increase in waste post implementation. Plate waste findings also were not significant. This might be explained by the recognition that because fruit and vegetable purchases increased, so did fruit and vegetable waste. Another explanation might be due to the school's county demographics and social determents of health. Unmeasured confounders, like economic stability and health literacy, could explain why School 1 student's made decision. School 1 is ranked in the bottom 25 of County Health Rankings, listed 96 out of 120 Kentucky counties (County Health Rankings, 2020). Students could be unfamiliar with fruit and vegetable options, making them less likely to try or consume more nutritious options. In addition, effect modification of the food service staff could be an issue with a third factor being different levels of interest, willingness to engage or buy-in of the program. Because of this School food service staff should receive annual professional development and training to ensure that they

have the knowledge, interest, and skills to implement nutrition education programs.

Although School 2 County Health Rankings placed them in the top 50% of Kentucky counties, ranking 46th out of 120, School 2 had room for improvement when it came to health outcomes. School 2 selected one intervention and self-reported that all four intervention elements were either partially implemented (three elements) or fully implemented (one element) at the time of the last status update. Even though School 2's descriptive statistics showed a slight increase in the number of fruit and vegetable servings sold, it was not found to be significant. Likewise, School 2's descriptive statistics showed a slight decrease in fruit and vegetable waste, but it too was not found to be significant. However, sizeable changes did take place in School 2. This school was able to increase fruit and vegetable purchases by 8.62%, while simultaneously decreasing plate waste by 26.83%. This discovery is promising, since both objectives are moving in the direction hypothesized by researchers. School 2 had room to grow, and the descriptive statistics suggested that change happened. These findings could be due to social determents of health being an unmeasured confounder, explaining our findings of considerable change in School 2 but statistically insignificant results. Qualitative findings from food service staff also indicated that the school's environment made it difficult to execute proper implementation of Smarter Lunchroom elements. Food service staff reported in Table 9, Chapter 4, that "Part of the issue is space available on the serving line to display." In short, continued focus on environmental factors can help increase fruit and vegetable purchases, while simultaneously decreasing fruit and vegetable waste.

School 3 is located in the highest populated (26,533 people) and wealthiest participating county. The median household income was $66,200, nearly double that of School 1. School 3 also resided in the most educated participating county, higher than the state average, with the lowest unemployment rate. School 3 only had 50% students eligible for NSLP and 13% in poverty. Overall, School 3 had better health factors and health outcomes,

leading to more opportunities for good health among students. This school selected one intervention and self-reported that all four intervention elements were fully implemented at the time of the last status update. School 3's implementation of PSE strategies at baseline were higher than any other school and could account for some differences seen in the results. School 3 was the outlier when it came to the number of fruit and vegetable servings purchased and was the only participating school whose descriptive statistics showed a slight decrease in fruit and vegetable servings post intervention. Fruit and vegetable purchases decreased by 4.65%. Consequently, there was no significant increase in the number of fruit and vegetables purchased after the intervention. Conversely, School 3 was the only school that showed a significant decrease (p<0.05) in plate waste after the intervention (p=0.023). This might be explained by the social determents of health and students being exposed to a healthy school nutrition environment, as well as having access to fruits and vegetables at home. By modeling health behaviors at home, parents could reinforce health behaviors students are learning in school. Research trends have shown there's an influence of locations that rank higher in health behaviors being able to maintain those influences and improvements in health (Wahowiak, 2017). This pattern contributes to the consistent nutrition messaging about the importance of consuming healthy foods. Bias exposure effect could have taken place in School 3 where they were more likely to adopt ideas that they were repeatedly exposed to in their cafeteria. Therefore, students at School 3 were more likely to consume more fruits and vegetables, and have less food waste than other participating schools. School 3 decreased fruit and vegetable waste by 18.27% following intervention implementation. This might also be explained by the decrease in the number of fruit and vegetable servings purchased which in turn caused a reduction in fruit and vegetable waste.

Fidelity Checklists

The fidelity checklists were used to determine the extent in which Smarter Lunchroom interventions were implemented throughout the study at each

participating location. They relied exclusively on self-reported data, completed by UK FCS Extension Agents and school food service staff. At the end of the study period, based on self-reported data from the post-implementation fidelity checklists, all participating schools had increased the number of intervention elements implemented either partially or fully. According to the three-week follow-up fidelity checklist, the score for partially implemented intervention elements increased in School 2, while Schools 1 and 3 were able to maintain or increase intervention elements being fully implemented. However, self-reported data should always be interpreted with caution, as respondents might be inclined to give socially desirable answers.

Limitations

Limitations of this study include a smaller than expected sample size, which makes causality unachievable. A small sample size (n) can also reduce the power of a study and increase the margin of error. Interpreting results becomes more difficult, because of large standard of error, which in turn creates a wide confidence interval and an imprecise estimate of the effect or p-value. Therefore, it becomes harder to interpret the effect size and come to a firm conclusion. However, using a paired sample T-test for small sample sizes has been shown to increase accuracy. In order for the findings to be more representative of the Kentucky middle school population, more than three schools are required. A larger sample size will increase the accuracy of the research, as well as its general ability and external validity.

Also, the Kentucky Nutrition Education Program's Smarter Lunchrooms Pilot Plate Waste Project used a Pre-Post design and was limited by the absence of a control group. Due to the absence of a control group, the ability to draw conclusions about the interventions effect was greatly weakened. By increasing the study sample, researchers could measure the difference between a control group and an experimental group. This would help rule out other factors that might have influenced the results. A control or comparison group would give a firm basis to conclude that the Smarter Lunchroom intervention was having a

reliable effect. Subsequently, a control group could increase the internal validity of the study.

In addition, researchers relied on self-reported data for all fidelity checklists at the three status update points from each participating school. This information was provided by the FCS County Agent. Self-reporting has its disadvantages, since subjects' answers may be biased towards reporting socially desirable scores. Deliberate deception might occur if participants believed that there was something to be gained from fraudulent responses. Moreover, content validity problems might occur because school staff and Extension Agents might misinterpret the questions. More supervision from the research team during implementation could aid in consistent and accurate reporting.

Another limitation was the use of food production records since the three schools used different templates. This difference could be a threat to the internal validity of the study as researchers might have interpreted records wrong. However, all schools participated in the NSLP and therefore were required to complete them. This vehicle proved to be the most feasible way to collect data and detect change in students' fruit and vegetable purchases. Although this study did not see any significant increases in fruit and vegetable purchases after the intervention, food production records did detect a slight increase in two of the participating schools. All the above-mentioned limitations can be overcome with a large-scale study that can provide more concrete evidence for the potential efficacy of the smarter lunchroom intervention.

Summary

The overall purpose of the KYNEP Smarter Lunchroom Pilot Project was to expand the use of PSE strategies across the state of Kentucky, increase the understanding of what successfully supports project implementation, and determine how implementation impacts middle school students' fruit and vegetable purchases and waste.

Hypothesis 1 stated that after six weeks of the KYNEP Smarter Lunchrooms Pilot Plate Waste Project intervention, participating Kentucky schools' students would increase their purchases of fruits and vegetables. Although, when stratified by schools, there seemed to be a trend toward an increase in fruit and vegetable servings purchased post intervention in two of the schools' descriptive statistics. School 2 generated a substantial 8.62% increase in fruit and vegetable purchases. Yet, the findings did not demonstrate a statistical significant increase in total fruit and vegetable purchases after implementation of the project. Therefore, researchers failed to reject the null hypothesis.

Hypothesis 2 stated that after six weeks of the KYNEP Smarter Lunchrooms Pilot Plate Waste Project intervention, participating Kentucky schools' students would reduce their fruit and vegetable waste. Combined, the findings did not demonstrate that there was a decrease in total fruit and vegetable waste after implementation of the project. Therefore, researchers failed to reject the null hypothesis. However, when stratified by schools, there seemed to be a trend toward a decrease amount of plate waste post intervention in two of the three participating schools. These findings surmise a magnitude of change, 26.83% reduction in fruit and vegetable waste outcomes after the intervention period in School 2. Yet findings only demonstrated a significant decrease in fruit and vegetable waste after implementation in School 3. Based on the findings of decreased plate waste in School 3, researchers rejected the null hypothesis for School 3.

Hypothesis 3 stated that after six weeks of the KYNEP Smarter Lunchrooms Pilot Plate Waste Project intervention, participating Kentucky schools' selected intervention implementations would impact purchasing and influence waste reduction. With substantial amount of change made throughout the pilot project, this study illustrates the advances that can be made in a short period of time with a limited sample size. Because there was no significant increase in fruit and vegetable purchases from before to after the intervention, as

well as no significant decrease in plate waste, researchers rejected the null hypothesis.

Implications for Future Public Health Research

Schools play a critical role in supporting a child's wellbeing. They have the opportunity not only to provide health education but also to reinforce healthy choices by implementing PSE strategies. Schools are in a unique position to promote healthy behaviors because most Kentucky children spend an average of 6 to 7 hours a day at school (National Center for Education Statistics, 2008; US Department of Health and Human Services, 2020). Findings from this pilot project can therefore be used to successfully implement PSE strategies, as well as tailor approaches to design future Kentucky Smarter Lunchroom Project interventions for school-based obesity prevention programs. This pilot study posits five implications for future public health research.

First, to improve fruit and vegetable consumption and to expand upon the Kentucky Smarter Lunchroom Project intervention success, the program duration needs to be lengthened beyond six weeks. Extending the study duration can enable researchers to improve the effect power and draw more reliable conclusions from the results. Six weeks of exposure may not be a sufficient amount of time to show an effect on health behavior. Interventions like the Healthier Generation's Healthy Schools Program (HSP), designed to guide schools and district staff as they implement health-promoting policy, practice, and environmental changes (Beam et al., 2012), are multi-year programs devoted specifically to school-based obesity prevention. Recent studies have demonstrated that the 2-4 year HSP design made significant changes in all content areas (policy and systems, school meals, competitive foods and beverages, health education, physical education, physical activity outside of physical education, before-and-after-school programs, and school employee wellness) by improving environmental policies and practices to prevent childhood obesity (Beam et al., 2012).

Second, the sample size of participating schools must be dramatically increased to ensure accurate findings, to share benefits, and reduce sampling error. In order to get an accurate picture of the effects of Smarter Lunchroom PSE changes on middle school students we need more examples. By having a small sample of 3 middle schools, we run a greater risk of the small sample being statistically significant just by chance. A larger sample size will increase the accuracy of the research, allowing us to generalize from the larger sample to more Kentucky middle school students.

Third, to reduce childhood obesity and improve academic outcomes for all Kentucky students, a collaborative approach is needed. Utilizing the Centers for Disease Control and Prevention's Whole School, Whole Community, Whole Child (WSCC) model is a new approach that could help improve each child's cognitive, physical, social, and emotional development (Lewallen et al.,2015). Qualitative data from School 3 confirms that this holistic approach is desirable: "a comment from a food service employee was about this intervention probably not having any effect on students' choices…. to make an impact would be more education, starting in the classroom, but also in the café, at evening school events, and throughout the school as a whole" (Chapter 4, Table 9). We know that nutrition education should initially be integrated throughout the school curriculum, while concurrently establishing an environment that supports students in consuming healthy foods and beverages (Lewallen et al.,2015). Based on our findings, we recognize that we must work in cooperation with participating schools and their communities to address childhood obesity, to ensure accurate findings and analyses, and to share benefits.

Fourth, future public health researchers should incorporate regular communication between practitioners, FCS Extension Agents, and school staff. To ensure widespread adoption of PSE strategies, efforts should include more FCS Agent training and food service staff education. This addition has significant implications for future implementation at other schools. For example, observations for fidelity checklists should be completed by research staff. This

change would add more comprehensive data, as well as improve the reliability of the findings. Future studies should carefully monitor implementation and clearly explain project goals with the potential impact on individual and community health. Closer oversight of the conditions in which participating schools are allowed to proceed can help future researchers reduce variation or deviation from the protocol. Given U.S. schools' limited financial and staff resources to address new governmental mandates (Peterson et al., 2007), research shows that obesity prevention efforts are more likely to be successful with support experts to both advise on the most effective strategies and support ongoing change (Madsen et al., 2015). When the entire school is involved; teachers, staff, and administrators can help reinforce nutrition standards by modeling healthy eating (Lewallen et al., 2015). Furthermore, interviews and focus groups with food service staff, teachers, and students would enhance the understanding of intervention effects.

Fifth, more Kentucky Smarter Lunchroom Project interventions should be conducted to explore the effectiveness of school-based PSE strategies on students' fruit and vegetable consumption using control groups, with pre intervention and post intervention data collection occurring within the same season, over an extended period of time. In the absence of a control group, we cannot assert any causal relationship between the Kentucky Smarter Lunchroom Project interventions and individual school progress. Although these schools might have made progress in the absence of the interventions, that is unlikely. Moreover, this quantification and impact of PSE work can be difficult to determine and evaluate, especially during a small duration of time. Because students' improvement in health behaviors is a process, more interventions are strongly recommended.

Although this pilot project found no statistically significant findings reflecting the extent of Smarter Lunchroom strategies implemented in the participating middle schools from pre to post intervention, its results nonetheless can meaningfully inform future approaches to improve students' fruit and vegetable purchases and consumption, and the subsequent waste. By

implementing PSE changes, our research can affect lasting change to schools' nutrition policies and environments. Even though this prospective research studied real-world implementation without the potential strengths of implementation under a rigorous research environment, it generated salient evidence on the impact of Smarter Lunchroom strategies. Most important, the identified interventions and the above five implications for future public health research should augment the implementation of future PSE strategies in middle schools to reduce childhood obesity. Increased opportunities for healthy decision making can reduce gaps in health disparities.

The goal of the Kentucky Nutrition Education Program is to educate limited resource families about making nutritious meals and thereby changing health behaviors necessary to maintain a healthy lifestyle. We want the KYNEP Smarter Lunchrooms Pilot Plate Waste Project to be implemented throughout the state and be successful where the need is greatest. Consequently, this work is focused on establishing health equity for all Kentucky children, regardless of race, ethnicity, gender, income, or location. When schools focus on creating healthier environments for both students and staff, everyone benefits. Reducing childhood obesity requires initiatives which increase opportunities at all Kentucky schools so that adolescents will grow up to be healthy adults. This mission requires improvements in school environments and resources like school nutrition services and marketing to encourage healthy choices. If foods offered in schools align with the NSLP dietary guidelines and if schools implement PSE changes, they can influence individual student choices and potentially have a population-level impact on health outcomes.

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