EFFECT OF NEW SODIUM REGULATIONS ON NATIONAL SCHOOL LUNCH PROGRAM MEAL CONSUMPTION OF MIDDLE SCHOOL STUDENTS IN A NORTHEASTERN OHIO SCHOOL DISTRICT

A thesis submitted to the Kent State University College of Education, Health, and Human Services in partial fulfillment of the requirements for the degree of Master of Science

By

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The United States Department of Agriculture and the National School Lunch Program sets regulations to participating school districts to provide healthy meals to the students. The first of three new sodium regulations was implemented in the 2014-2015 academic school year with the maximum target sodium level set at 1360 milligrams for a lunch meal. This study examined whether the new sodium guidelines affected the student consumption on selected entrées using plate waste pre-food and post-food photographs. Data was collected in a Northeastern Ohio middle school over three days in fall 2014 during lunch. A one-way ANOVA and independent t-tests were used to test for statistical differences. Four entrées and their individual components were examined. The only significant difference in consumption between days of data collection was found for the pizza sticks. There was also no significant difference between the production sales of each entrée for the current academic fall menu cycle as compared to the same time period of the previous academic year. The new sodium regulations were not found to affect student consumption in this study. An important limitation to this study was the discovery, following the data collection, that few changes in the sodium content of the foods actually occurred in light of unanticipated adjustments to the standardized recipes. This study does highlight challenges anticipated when lower sodium levels are implemented in upcoming years.
ACKNOWLEDGEMENTS

I would like to thank everyone involved in helping me finish my thesis, especially my thesis advisor, Barbara Scheule. She has guided and supported me ever since I began this journey a few years ago. I greatly appreciate all the advice and assistance with the few problems we encountered during the data analysis. She went above and beyond to help me finish and I cannot explain how much her support means to me. I greatly appreciate all the long revisions, late nights and last minute meetings.

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Much thanks goes out to my friends and family. They were there to motivate and push me through the toughest times while writing, collecting data, analyzing and making revisions. The one person closest to me provided the most push and motivation to finish this paper and kept telling me to keep going, even though at times I thought it was impossible. She always believed in me. This paper would not be finished without the help, guidance and motivation from everyone involved in my thesis journey.
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CHAPTER I

INTRODUCTION

National School Lunch Program Guidelines

The National School Lunch Program, under the United States Department of Agriculture (USDA) is the guiding force behind the meal programs in most school districts in the United States. It sets the food regulations that each school district must follow to stay under the National School Lunch Program. The Healthy, Hunger-Free Kids Act, and the Dietary Guidelines for Americans 2010 provide guidelines that the National School Lunch Program can use to develop its regulations on meals and reimbursable meals (USDA, 2013a).

Under the National School Lunch Program, based on income level, students can receive free and reduced price lunches (USDA, 2012a). The reduced prices vary across the United States based on different poverty levels. Schools receive a reimbursement from the government for every free and reduced price meal (USDA, 2012a). The reimbursement rates also differ across the United States because of the variance in food costs. In order to receive these reimbursements, students must have a reimbursable lunch. A reimbursable lunch is characterized as a meal where students select at least three of the five required meal components (USDA, 2013g).

The regulations placed by the National School Lunch Program are intended to provide healthier meals to the students in the district (USDA, 2013e). The most recent changes in the regulations were placed in January 2012 (USDA, 2012e). The regulations
include the types and quantities of fruits and vegetables, whole grains, and sodium levels that should be served as part of a lunch or breakfast served in schools (USDA, 2012b; USDA, 2012e).

In the 2014-2015 academic school year, the requirements for fruits and vegetables for all grades remains the same as the previous regulations. Whereby a student can choose both a fruit and a vegetable for the same meal of one-half to one cup of fruit and three-fourths to one cup of vegetables as the requirement that must be served daily during lunch (USDA, 2012c; USDA, 2013a; USDA, 2012e). Vegetables are divided into four groups, in which a vegetable from each group must be served every week. The vegetable groups include red/orange, dark green, beans/legumes, starchy and other vegetables (USDA, 2012b; USDA, 2012e).

The whole grain regulations have changed modestly in the last few years. In the 2012-2013 academic school year, the regulation of grains indicated that at least half of all grains must be whole-grain rich (USDA, 2012c). Beginning in the 2014-2015 academic school year, all grains must be whole-grain rich (USDA, 2012c; USDA, 2012e). Which means, it must be at least 51% whole grain-rich, whereby that whole grain is the first ingredient on the ingredient list (USDA, 2012b; USDA, 2014a).

Sodium was one of the new changes in the regulations. Since the new regulations were released in 2012, schools and the National School Lunch Program have made a more proactive approach to decreasing the overall sodium intake in children during breakfast and lunch. The sodium regulations are being decreased gradually to help the
students adjust to the sodium changes. The first target sodium level is set for the 2014-2015 academic school year and will decrease two other times in 2017-2018 and 2022-2023 (USDA, 2012b; USDA, 2012c). The sodium guidelines are the focus of this study. The goal of the National School Lunch Program is to increase consumption of healthy foods by increasing the amounts of fruits, vegetables, and whole grains available to students while decreasing sodium consumption (USDA, 2012b).

Health Implications of National School Lunch Program Guidelines

These reimbursable lunches provide healthy meals for students by including fruits and vegetables, whole grain-rich products and now, lower sodium foods. These foods are beneficial to one’s health in many different ways. Fruits and vegetables provide an array of vitamins, minerals and phytonutrients that has been shown to prevent some types of cancer, cardiovascular disease, and other health problems (Van Duyn & Pivonka, 2000; USDA & Health and Human Services, 2010). Whole grain-rich products contain vitamins and minerals, including fiber that helps prevent cardiovascular disease (USDA & HHS, 2010; USDA, 2012b). Later in life, a history of a high sodium diet has shown to increase the chances of developing hypertension, cardiovascular disease and kidney problems (Whelton et al., 2012; USDA, 2010b; American Heart Association, 2011).

Americans are not eating the recommended amount of fruits, vegetables, and whole grains daily and are consuming too much sodium (USDA & HHS, 2010). Individuals should be eating at least five cups fruits and vegetables daily (USDA, 2010a). On a per capita average in 2011, Ohio adolescents consumed no more than 1.1 servings
of fruits and vegetables daily (National Center for Chronic Disease Prevention and Health Promotion, 2013). Individuals should be eating more whole grain-rich products and less refined grain products. Whole grain-rich products should make up at least half of the grains in the diet daily and currently, on a per capita basis, Americans are eating less than one ounce of whole-grain rich products daily, while the recommended amount is at least 3 ounces (USDA and HHS, 2010). High sodium intake comes from processed foods and the addition of sodium during and after food is prepared either at home or in restaurants (CDC, 2014; Whelton, et al., 2012; American Heart Association, 2014b; USDA & HHS, 2010; American Heart Association, 2014a). The average American consumes more than the recommendation of less than 2300 milligrams daily. Children aged between 12-19 have a sodium intake between 2900 and 4500 milligrams a day (USDA & HHS, 2010).

**Implementation of National School Lunch Program Guidelines**

School food service directors are making adjustments to menus and food products to meet the new guidelines for the 2014-2015 academic school year. Likewise, food manufacturers are making changes by producing low sodium foods that will fit within the school meal guidelines. The length of time between each sodium decrease in the USDA guidelines allows manufacturers more time to formulate new products (USDA, 2012b). Food manufacturers also have to produce whole grain-rich products for the school market. Food service personnel are worried that these new products, either lower sodium or whole grain-rich, will not be accepted well by students (USDA, 2014b).
The incorporation of more fruits, vegetables, whole grain-rich products and lower sodium foods are expected to have a more healthful impact on students. These guidelines were set to provide healthier meals that would better students’ health and form good eating habits. A habit of eating more fruits and vegetables can prevent certain types of cancer and other diseases, and more whole grain-rich products can help decrease the risk for heart disease and stroke (Van Duyn & Pivonka, 2000; USDA & HHS, 2010; USDA, 2012b). A habit of eating lower sodium foods early in life can help prevent high blood pressure and heart disease (USDA, 2010b).

**Purpose Statement**

The purpose of this study is to examine the consumption of foods typically associated with high sodium intake, and determine whether the new sodium regulations had an effect on the National School Lunch Program meal consumption in a Northeastern Ohio Middle School.

**Hypotheses**

Using plate waste data from the current year and production record data comparing the 2013-2014 and 2014-2015 academic school years, our hypotheses include:

1. A significant decline is expected for the pizza stick consumption between data collection days 1, 2 and 3.

2. A significant decline is expected for the marinara sauce consumption served with pizza sticks between data collection days 1, 2, and 3.
3. A significant decline is expected between the sales (production data) of the pizza sticks and marinara sauce between data collection days 1, 2 and 3.

4. A significant decline is expected for the grilled cheese and tomato soup consumption between data collection days 1 and 3.

5. A significant decline is expected between the sales (production data) of the grilled cheese and tomato soup between days 1 and 3.

6. Based on a pre-test post-test plate waste design during the five-week menu cycle, no significant difference between genders on sodium consumption is expected.

7. Overall, food sales and production will be higher in the 2013-2014 academic school year as compared to the 2014-2015 academic school year when controlled for the amount of students who purchased lunch on a daily basis.
KEY DEFINITIONS

Plate waste- Measurement of food left over on tray after a student is finished with his/her meal.

Sodium-reduced food- Food items that underwent a decrease in sodium content to follow the National School Lunch Program guidelines.

Production record- The daily document that tracks what foods are served and how much food is produced, leftover and served.

Cashier report- The daily report stating the amount of students who purchased a lunch and the proportion of those students who received a free, reduced or full price lunch.

Reimbursable meal- A meal that is regulated by the government that a school district must serve to receive reimbursement. For example, the government requires that a fruit or a vegetable must be served with every free or reduced student’s meal (USDA, 2012d).
CHAPTER II

REVIEW OF LITERATURE

National School Lunch Program

The National School Lunch Program in the United States was created under the National School Lunch Act, and President Harry Truman signed it into law in 1946 (USDA, n.d. a). Every year, it offers its services to over 100,000 public and non-profit private schools, including child-care businesses (USDA, 2012a). The program provides nutritious foods at a low-cost or free lunch to children every school day (USDA, n.d. a). In 1998, the program expanded to include reimbursable afterschool snacks. On a Federal level, the United States Department of Agriculture (USDA) controls the Food and Nutrition Service program by setting the guidelines for each state (USDA, 2012a).

The National School Lunch Program (NSLP) is a program under the USDA, in which, the State education agencies operate the program using the set of guidelines and forming agreements with school food authorities (USDA, 2012a). The School Breakfast Program (SBP) functions like the National School Lunch Program and offers free and reduced breakfast to more than 89,000 schools and institutions (USDA, 2013d).

Nutritional Mandate

In the National School Lunch Program, schools receive funding and food from the United States Department of Agriculture for every reimbursable meal served. The lunch must meet Federal requirements, including the types of food that must be served on each plate. The afterschool snacks can be reimbursable, but must also follow the guidelines
(USDA, 2012a). Every meal served must be nutritionally adequate whether it is breakfast, lunch or snack.

The Healthy, Hunger-Free Kids Act (HHFKA) was enacted in 2010 serving as legislation for numerous children nutrition programs including the National School Lunch Program, the School Breakfast Program and the Summer Food Service Program. This legislation gave the schools the ability to enhance their current school lunch and breakfast programs by providing healthier meals for millions of children (USDA, 2013e).

The Healthy, Hunger-Free Kids Act of 2010 guided the USDA to make the appropriate changes to the lunches based on the 2010 Dietary Guidelines for Americans. The National School Lunch and Breakfast Program were updated to remain consistent with the HHFKA update and the 2010 Dietary Guidelines for Americans (USDA, 2013a).

In January 2011, the USDA proposed a set of rules intended to improve the school lunch and breakfasts. These rules must be reviewed every three years to ensure they are consistent with the HHFKA and the 2010 Dietary Guidelines for Americans. These regulations began in the 2012-2013 academic school year. Some rules include offering fruits and vegetables as two separate components, offering fruit during breakfast and lunch, offering whole grain products, offering a daily meat/meat alternative at breakfast, offering fat-free flavored and unflavored milk, as well as, low-fat unflavored milk (USDA, 2012b; USDA, 2012e). The schools also have specific caloric ranges for different age groups. The sodium content of the meals should be decreased gradually
over the future school years and every meal should have zero trans-fat per serving (USDA, 2012b).

In the 2012-2013 school year, this new meal pattern was implemented to increase the availability of fruits, vegetables, and whole grains. A calorie limit per lunch for all grades was set for the first time. The amount of sodium per lunch in the 2012-2013 school year was reduced, and it will continue decreasing in the future (USDA, 2012a).

Figure 1 lays out the school lunch meal requirements.

<table>
<thead>
<tr>
<th>Food Group</th>
<th>Kindergarten- Grade 5</th>
<th>Grades 6-8</th>
<th>Grades 9-12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calories</td>
<td>550-650</td>
<td>600-700</td>
<td>750-850</td>
</tr>
<tr>
<td>Grains</td>
<td>1 oz eq. minimum daily (8-9 weekly)</td>
<td>1 oz eq. minimum daily (9-10 oz weekly)</td>
<td>2 oz eq. minimum daily (10-12 oz weekly)</td>
</tr>
<tr>
<td>Whole Grains</td>
<td>All grains must be whole grain-rich</td>
<td>All grains must be whole grain-rich</td>
<td>All grains must be whole grain-rich</td>
</tr>
<tr>
<td>Fruit(^a)</td>
<td>(\frac{1}{2}) -1 cup per day</td>
<td>(\frac{1}{2}) -1 cup per day</td>
<td>(\frac{1}{2}) -1 cup per day</td>
</tr>
<tr>
<td>Vegetables(^a)</td>
<td>(\frac{3}{4}) -1 cup per day</td>
<td>(\frac{3}{4}) -1 cup per day</td>
<td>(\frac{3}{4}) - 1 cup per day</td>
</tr>
<tr>
<td>Meat/Meat Alternate</td>
<td>1 oz eq. minimum daily (8-10 oz weekly)</td>
<td>1 oz eq. minimum daily (9-10 oz weekly)</td>
<td>2 oz eq. minimum daily (10-12 oz weekly)</td>
</tr>
<tr>
<td>Milk</td>
<td>1 cup</td>
<td>1 cup</td>
<td>1 cup</td>
</tr>
</tbody>
</table>

*Figure 1. National School Lunch Program Regulations (January 26, 2012)*

\(^a\)Fruits and vegetables are two different categories. Students can choose to get \(\frac{1}{2}\)-1 cup fruit and \(\frac{3}{4}\) -1 cup vegetable per day.

Source: USDA, 2012c; USDA, 2013a; USDA, 2012e

The new breakfast meal pattern beginning in the 2014-2015 academic school year includes offering vegetables in place of fruit, offering meat or meat alternates in place of grains and offering vegetables or meat/meat alternates as extras. In other words, a child
can choose a vegetable over a fruit and can choose a meat option instead of a grain when offered them at breakfast (USDA, 2012b; USDA, 2013b). At least one grain is served per day at one ounce. Overlapping kindergarten to grade 12, nine ounces of grains weekly can be served (USDA, 2013c).

From kindergarten to grade 5, grades 6 to 8 and grades 9 to 12, the categories for calories at breakfast should be between 350-500, 400-550, and 450-600, respectively. Beginning in the 2014-2015 academic school year, one cup of fruit must be served for breakfast (USDA, 2012b). One cup of milk, one-half cup of vegetables and one ounce of grain must be served on a daily basis (USDA, 2013c; USDA, 2012c; USDA, 2012e).

Figure 2 shows the breakfast requirements for each meal component.

<table>
<thead>
<tr>
<th>Food Group</th>
<th>Kindergarten- Grade 5</th>
<th>Grades 6-8</th>
<th>Grades 9-12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calories</td>
<td>350-500</td>
<td>400-550</td>
<td>450-600</td>
</tr>
<tr>
<td>Whole Grains</td>
<td>1 oz eq. minimum (7 oz eq. weekly)</td>
<td>1 oz eq. minimum (8 oz eq. weekly)</td>
<td>1 oz eq. minimum daily (9 oz eq. weekly)</td>
</tr>
<tr>
<td>Fruit</td>
<td>1 cup per day</td>
<td>1 cup per day</td>
<td>1 cup per day</td>
</tr>
<tr>
<td>Vegetables</td>
<td>½ cup per day</td>
<td>½ cup per day</td>
<td>½ cup per day</td>
</tr>
<tr>
<td>Meat/Meat Alternatea</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Milk</td>
<td>1 cup</td>
<td>1 cup</td>
<td>1 cup</td>
</tr>
</tbody>
</table>

*Figure 2. School Breakfast Program Regulations 2014-2015 (July 2013)*

*aMeat/meat alternate may be offered at 1 oz. eq. when the weekly grain requirement is met (USDA, 2012e). Source: (USDA, 2013c; USDA, 2012b; USDA, 2012c; USDA, 2012e)*

**Fruits and vegetables.** The fruit and vegetables are also regulated in the National School Lunch Program. The fruit and vegetables offered during lunch must be different each day. The different vegetables consist of red/orange, dark green,
beans/legumes, starchy and other vegetables (USDA, 2012b; USDA, 2012c). For lunch, schools must offer one-half cup to one cup of fruit per day for all age groups and three-fourths of a cup to one cup of vegetables per day for all age groups. For breakfast, the new 2014-2015 guidelines state that schools must offer one cup of fruit per day for all ages as opposed to the previous guidelines of offering one-half cup (USDA, 2013c; USDA, 2012b; USDA, 2012c; USDA, 2012e).

**Whole grains.** The whole grain requirements for the 2014-2015 academic school year require a greater proportion of whole grains than the previous years. The requirements from 2012 to 2014 were that half of the grains served must be whole grain-rich. The other half of the grains were allowed to be refined and enriched grains. Schools must be serving all whole grain-rich foods in the 2014-2015 school year. In order for a food to be considered whole grain-rich, the food item must be at least 51% whole grain-rich by weight or it should be the first ingredient (USDA, 2012b; USDA, 2014a). Schools must serve at least one-ounce equivalent of whole grains daily and must meet the weekly grain requirements for each age group for both breakfast and lunch (USDA, 2013c; USDA, 2012c; USDA, 2012e).

**Sodium.** A mandate for sodium has been issued pertaining to the amounts of sodium per meal per age group in schools. Across a ten-year period, the sodium amounts are reduced at three target levels for both breakfast and lunch meals to let the children adjust to the new taste of lower sodium foods. The first target must be met in the 2014-2015 school year. The second target level is set for the 2017-2018 school year and the
third level is set for the 2022-2023 school year (USDA, 2012c; USDA, 2012b). These target levels were established in 2012 to be in accordance with the Dietary Guidelines for Americans 2010. Schools must be compliant with the regulations by July 1 of their target year (USDA, 2012b). Figures 3 and 4 provide the breakfast and lunch regulations on the sodium targets.

<table>
<thead>
<tr>
<th>Age/Grade Group</th>
<th>Current Baseline Levels (mg)</th>
<th>Target I- SY 2014-2015 (mg)</th>
<th>Target II- SY 2017-2018 (mg)</th>
<th>Target III- SY 2022-2023 (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grades K-5</td>
<td>573</td>
<td>≤ 540</td>
<td>≤ 485</td>
<td>≤ 430</td>
</tr>
<tr>
<td>Grades 6-8</td>
<td>629</td>
<td>≤ 600</td>
<td>≤ 535</td>
<td>≤ 470</td>
</tr>
<tr>
<td>Grades 9-12</td>
<td>686</td>
<td>≤ 640</td>
<td>≤ 570</td>
<td>≤ 500</td>
</tr>
</tbody>
</table>

*Figure 3. Sodium Regulations for Breakfast*

Source: USDA, 2012b; USDA, 2012c

<table>
<thead>
<tr>
<th>Age/Grade Group</th>
<th>Current Baseline Levels (mg)</th>
<th>Target I- SY 2014-2015 (mg)</th>
<th>Target II- SY 2017-2018 (mg)</th>
<th>Target III- SY 2022-2023 (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grades K-5</td>
<td>1377</td>
<td>≤ 1230</td>
<td>≤ 935</td>
<td>≤ 640</td>
</tr>
<tr>
<td>Grades 6-8</td>
<td>1520</td>
<td>≤ 1360</td>
<td>≤ 1035</td>
<td>≤ 710</td>
</tr>
<tr>
<td>Grades 9-12</td>
<td>1588</td>
<td>≤ 1420</td>
<td>≤ 1080</td>
<td>≤ 740</td>
</tr>
</tbody>
</table>

*Figure 4. Sodium Regulations for Lunch*

Source: USDA, 2012b; USDA, 2012c

**Financial**

The formation of the National School Lunch Program comes after a history of increasing participation in school lunch programs and increasing Federal and State funding. American children were malnourished and unable to focus on school, consequently school officials and the government wanted to start providing lunch to those
children (Gunderson, 1971). It was important to find ways to support the need for school lunches.

In the early years of the National School Lunch Program, the food schools received were funded in part by many organizations and the Federal and State governments, especially by the Works Progress Administration in 1935 (Martin & Oakley, 2008, p. 64). The Works Progress Administration provided funds and labor for schools, which helped keep the meal prices low and free for needy children (Martin & Oakley, 2008, p. 65).

In the 1930s, the Federal and State governments worked with local agricultural leaders to form commodity donation programs that provided foods to schools all across the country. Providing food to schools across the country developed into a large program that sent food to over forty-five thousand schools and served 6.7 million children daily which lead to the National School Lunch Act of 1946 (Gunderson, 1971).

As the National School Lunch Act expanded, it led to the Child Nutrition Act of 1966 and many other amendments making the National School Lunch Program what it is today. These amendments included those involved with the Breakfast program, Special Milk Program and funding issues (Gunderson, 1971).

The children from families who have an income of 130% or below the poverty level are eligible for free meals. Families who have an income of between 130 and 185% of the student poverty level are eligible for reduced-price meals. These meals do not cost the student more than 40 cents. Children from families with an income of over 185% of
the poverty level pay the full price for lunch. Schools receive reimbursement from USDA for the free and reduced-priced meals served, as well as a small reimbursement for the full-price meals that meet the required meal guidelines (USDA, 2012a).

All students who are eligible for free meals under the National School Lunch Program also receive free breakfast and milk under the School Breakfast Program and Special Milk Program, respectively. The schools send home a form with the students, including the newly enrolled children, at the beginning of every school year offering the chance for families to apply for free or reduced price meals, as required by USDA. Each student receives free or reduced meals for a full school year (USDA, 2011a).

Every school meal served has a reimbursement rate that the school receives in exchange for serving a reimbursable lunch. Reimbursement rates vary for school districts of different student poverty levels. For every reimbursable paid lunch in the 2013-2014 school year, schools throughout the contiguous United States receive between twenty-eight and forty-two cents from the government. For every reimbursable reduced price meal, schools receive between $2.53 and $2.76. For every reimbursable free meal, schools receive between $2.93 and $3.16 (Rowe, 2013; USDA, 2012d).

**Reimbursable meals.** A reimbursable meal qualifies for funding from the USDA under the National School Lunch Program. There are various funding levels for meals that are free, reduced or full-priced. Students who are eligible for a free or reduced-price meal, and choose to receive a meal under the National School Lunch Program must purchase a reimbursable meal. Under Offer versus Serve, a school must offer the
requirements for grain, meat/meat alternative, fruit, vegetable, and milk. For a meal to be considered reimbursable from the government, the meal selected by the student must contain three of the five components, including a fruit or vegetable as one of the three. All free and reduced price students must purchase a reimbursable meal, since the government funds their meals. A full-price student is not required to purchase a reimbursable meal and they are able to purchase an entrée as an a la carte item (USDA, 2013g).

For example, a reimbursable meal can contain a banana and a cheeseburger. The bun of the cheeseburger is the grain, the hamburger is the meat/meat alternative and the banana is the fruit. These three components make up a reimbursable meal and qualify for USDA funding. A full-price student can purchase just a hamburger and it is not reimbursable; however, if they buy a fruit with their meal, it is now considered reimbursable by the government (USDA, 2013g).

**Concerns About Eating Habits**

The eating habits of children are a concern to parents, doctors and teachers, as the rise of obesity continues. The Centers for Disease Control and Prevention (2013a) reports that childhood obesity has tripled from the last generation, rising to 17%. The rise of obesity in children has been attributed to low physical activity and a high consumption of calories both related to school and home life. The school environment factors that affect childhood obesity include a lack of daily physical activity, higher
consumption of sugary drinks, and less healthy foods (Centers for Disease Control and Prevention, 2013b).

**Physical Activity**

The latest guidelines for physical activity levels in children and adolescents aged 6-17 years are at least 60 minutes of physical activity daily. The physical activity should be a combination of aerobic, muscle strengthening, and bone strengthening exercises (United States Department of Health and Human Services, 2008). The Center for Disease Control and Prevention (2012) conducted a nationwide study in 2011 looking at youth behaviors, including physical activity and eating habits. In this nationwide study, only 13.8% of students did not partake in at least 60 minutes of physical activity on any one of the seven days before the survey was conducted. This physical activity includes any type of physical activity that increased the students’ heart rate and made them breathe hard at any one point. Just over forty-nine percent of students participated in at least 60 minutes of physical activity on 5 or more days that week. Almost twenty-nine percent of students participated in hard physical activity all seven days of the week for at least 60 minutes per day (Eaton, et al., 2012). According to Eaton, et al. (2012), less than a third of high-school aged students are getting the recommended amount of exercise daily (United States Department of Health and Human Services, 2008).

The factors that influence childhood obesity at school also relate to the factors that influence it at home. At home, children spend too many hours watching television and playing video games. A 2009 study concerning the influence media has on children
aged 8-18 years found that children spend an average of 7.5 hours per day watching television and movies, using the computer, and playing video games instead of using that time participating in physical activities (CDC, 2013b; Rideout, Foehr, & Roberts, 2010). Food service directors can provide healthier meals for students to increase the nutrition of students who have low physical activity outside school.

**Competitive Foods**

Competitive foods and other a la carte sales provide revenue for a school food service organization; however, these foods can have a negative effect on the children’s health when students select unhealthier options (Bevans, Sanchez, Teneralli, & Forrest, 2011; USDA, 2013a). Competitive foods are defined as food and beverages sold throughout the school day that is not part of the reimbursable lunch under the National School Lunch Program or Child Nutrition Act (USDA, 2013f; Bevans et al., 2011; Institute of Medicine, 2007; USDA, 2013a). A la carte items are competitive foods that are part of the NSLP; however, the food does not count as a reimbursable lunch. An example is a student just purchasing an entrée or side dish (USDA, 2013a).

The Institute of Medicine (2007) developed standards for competitive foods when sold in the school. It relates to the Dietary Guidelines for Americans of 2010, as well as, the NSLP meal regulations. The first standard states that all snacks, food and beverages must not have more than 35% of total calories from fat and less than 10% of total calories from saturated fats. These food items must also have less than 35% of calories from total sugars and snacks must not exceed 200 calories (Institute of Medicine, 2007).
The USDA (2013a) also developed new food standards on what can be served in a school as a competitive food to improve the healthiness of these foods. All competitive food items sold in a school must meet all the competitive nutrient guidelines and all grain items must be whole grain-rich. All other food groups such as fruits, vegetables or dairy products are also allowed as a competitive food. The foods may also contain at least ten percent of the Daily Value (DV) of vitamins or minerals (USDA, 2013a).

Competitive and a la carte foods serve as an alternative to the NSLP meals, contributing to revenue gained from the sale of these foods and a decreased participation in the program (USDA, 2012b). The competitive foods and a la carte items are usually not as nutritionally adequate as the more regulated lunch. When students purchase these items more often than the lunch, it arises as an unhealthier eating habit (Bevans et al., 2011; USDA, 2013a). Schools use the 2010 Dietary Guidelines to build a healthy competitive food and beverage policy. These go along with the previous regulations stated; however, schools are not always in full compliance (Schneider, Schermbeck, Chiqui, & Chaloupka, 2012).

In some cases, schools only sell healthy items a la carte. Wordell, Daratha, Mandal, Bindler, and Butkus (2012) examined whether modifying the a la carte items would change the students’ food choices. The intervention schools provided 100% juice, milk, and more fruits and vegetables as options while cutting out all sweetened beverages, candy, and chips. The control schools just added a fresh fruit and vegetable bar, just like the intervention schools. There was no difference in fruit and vegetable
consumption between schools; however, the findings in this study show that healthy changes in a school environment are positively linked to healthy food behaviors (Wordell, Daratha, Mandal, Bindler & Butkus, 2012).

**Ohio Legislation Affecting School Lunch**

On the Federal level, the government sets the regulations that each state must follow using the Healthy, Hunger Free Kids Act of 2010 and the Dietary Guidelines of America 2010 (USDA, 2012a). The Ohio Department of Education (ODE) is responsible for the school districts under the National School Lunch Program in Ohio (ODE, 2015b). The Ohio United States Department of Agriculture Foods Program distributes food such as meats, cheese, fruits and vegetables to schools under the National School Lunch Program (ODE, 2015a). The Ohio Department of Education works with the Office for Child Nutrition and the United States Department of Agriculture to enforce the regulations placed on the meal requirements for the free and reduced price meal students for both breakfast and lunch meals. The ODE also administers the Special Milk Program, After School Care Snack Program, and the Government Donated Food or Commodity Programs (ODE, 2015b).

**Health Implications of Diets Impacting Children Today**

Fruits, vegetables, whole grain-rich products and lower sodium foods can have beneficial effects on a child’s health. Fruits, vegetables and whole grain-rich products contain essential vitamins and minerals that can prevent adverse health effects that can arise when these foods are not consumed (Van Duyn & Pivonka, 2000; USDA & HHS,
A diet high in sodium can also have harmful effects on the body (American Heart Association, 2014a).

**Fruits and Vegetables**

Fruits and vegetables have been linked to preventing certain types of cancer, as well as, lowering the risk of cardiovascular disease, heart attack, and stroke. Individuals who consume more than or about 4-5 cups servings of fruits and vegetables daily potentially have a more protective effect against cancer. Many vitamins, minerals and phytochemicals are responsible for the potential protection against such health problems (Van Duyn & Pivonka, 2000; USDA & HHS, 2010; USDA, 2015).

Fruits and vegetables are important also because they prevent many types of eye diseases when eating them early in life. Cataracts are just one eye problem that can occur with a low intake of fruits and vegetables. Fruits and vegetables that contain high levels of antioxidants, vitamins A, C, E and carotenoids keep the eyes healthy (USDA, n.d. b). Also, fruits and vegetables high in fiber, folic acid, and beta-carotene have shown to lower the risk of cataracts later in life (Van Duyn & Pivonka, 2000; Iyasele & Akpe, 2009). Children who have a regular intake of these vitamins and minerals have a better chance of preventing these problems from happening in the future.

Fruits and vegetables are also important for the prevention of gastrointestinal diseases. Diverticulosis is a disease of the gastrointestinal tract where the tract becomes inflamed and makes it harder for digestion to continue. Dietary fiber is known to help digestion through the inflamed gastrointestinal tract by pulling moisture from the
surrounding tissue; therefore, high fiber diets are recommended for individuals with diverticulosis. Some fruits and vegetables are known to be high in insoluble fiber. Children who have a regular diet consisting of vegetables containing insoluble fiber and legumes can prevent diverticulosis from developing in the future (Van Duyn & Pivonka, 2000). Dietary fiber can also reduce the risk of developing type-2 diabetes and obesity (USDA, n.d. b).

Diets high in fruits and vegetables can also improve energy during the day and prevent obesity by providing fewer calories and more nutrients. At least four to five cups of fruits and vegetables are the recommended intake for individuals daily to maintain a healthy lifestyle and increase health benefits (USDA, 2010a). Fruits and vegetables are made up of many other nutrients including folate, potassium, magnesium, and vitamins A and K (Van Duyn & Pivonka, 2000; USDA & HHS, 2010). Obesity is one of the main concerns in children today. Eating a healthy diet consisting of colorful vegetables and different fruits can help to decrease obesity (USDA & HHS, 2010).

**Whole Grains**

Whole grains are an important part of an individual’s diet. Americans eat more refined grains compared to whole grains. Refined grains are processed whole grains to increase shelf life, while removing most vitamins, minerals and dietary fiber. Most refined grains are enriched with other nutrients such as iron, thiamin, riboflavin, niacin and folic acid; however, not all the original nutrients are enriched into these grains. Many foods prepared with refined grains, such as cookies, cakes, and pies, are also high
in solid fats and added sugars. Whole grain-rich products contain more fiber and
nutrients (USDA & HHS, 2010; USDA, 2012b).

The original nutrients in whole grain products include iron, magnesium, selenium, B vitamins and dietary fiber. Eating the recommended amount of whole grains daily has shown to decrease the risk of cardiovascular disease (USDA & HHS, 2010; USDA, 2012b). The recommended daily amount of whole grain intake is at least three servings per day. Most individuals are eating less than one serving of whole grain daily (Hur & Reicks, 2012). Hur and Reicks (2012) found a positive relationship between high intakes of whole grain and prevention of cardiovascular disease, as well as, an increase in energy.

**Sodium**

Sodium intake begins to affect the body early in life when it is consumed in great amounts. It is important that adults watch their sodium intake and the overall intake within the household. Lower sodium foods within the home will help children to avoid developing bad habits of eating high sodium foods. Lower sodium foods are recommended for all ages to reduce the risk of high blood pressure and heart disease later in life (USDA, 2010b).

Sodium is considered an essential nutrient since the body cannot synthesize it, so some sodium must be in the diet; however, too much sodium can harm the body (American Heart Association, 2014a). The average sodium intake for individuals aged 2 years and older is 3400 milligrams per day. The Dietary Guidelines for Americans of 2010 recommends sodium intake for Americans is less than 2300 milligrams per day,
while the adequate intake for Americans is 1500 milligrams per day (USDA & HHS, 2010; Sebastian, R. S., Enns, C. W., Steinfeldt, L. C., Goldman, J. D., Moshfegh, A. J., 2013). Adequate intake is the recommended amount an individual should intake to sustain a healthy lifestyle (Barr, Murphy & Poos, 2002; USDA & HHS, 2010).

Individuals who are either older than 51, African American, already have high blood pressure, diabetes or chronic kidney disease should be more aware of their sodium intake and potassium intake as these individuals are more prone to the effects of sodium on the body (CDC, 2014).

Sodium has a harmful effect on the body when consumed in large quantities. High intakes of sodium raise an individual’s blood pressure. High blood pressure raises the likelihood of developing cardiovascular disease (American Heart Association, 2011; Whelton et al., 2012). Cardiovascular disease or heart disease is related to a condition called atherosclerosis. Atherosclerosis is characterized as the addition of plaque to arteries around the heart making it more difficult for blood to flow through. Blood pressure is higher when the blood has to work harder to flow through the body (American Heart Association, 2011). Excess sodium in the body causes a buildup of fluid, which raises blood pressure and forces the heart to work harder (American Heart Association, 2014a). Excess sodium can produce the following effects on the body: reduce the efficacy of high blood pressure medications, ventricular hypertrophy or the enlargement of the muscle tissue in walls of the heart, and diastolic dysfunction or the abnormal pumping of blood through the heart. High amounts of sodium can also cause
perivascular fibrosis of the coronary arteries or the formation of fibrous tissue on the vessel walls of the heart (Whelton et al., 2012; USDA, 2010b). Excess sodium in the body can also cause kidney disease (Whelton et al., 2012).

Low sodium intakes have shown to decrease health risks such as high blood pressure, cardiovascular disease and stroke. As sodium intake decreases in children, their blood pressure also decreases, showing that the risk of hypertension decreases in adulthood (USDA, 2010a; USDA, 2010b). The effects of high sodium intake on blood pressure begin in childhood (USDA, 2010b). A high intake of potassium with a lower intake of sodium has shown to help decrease blood pressure (USDA, 2010a; USDA, 2010b).

**Food Intake Among Children, Adolescents and Adults**

Americans’ diets consist of a low intake of fruits, vegetables and whole grain-rich products and a high intake of sodium. This includes children, adolescents and adults. They are consuming less than the recommended servings of fruits and vegetables and whole grain-rich products. Americans are also eating more than the recommended consumption of less than 2300 milligrams of sodium per day (USDA & HHS, 2010).

**Fruit and Vegetable Intake**

In the United States, Americans consume lower than the recommended amount of vegetables, along with fruits, whole grains, and milk (USDA & HHS, 2010). Four to five cups of fruits and vegetables are the recommended daily intake (USDA, 2010a; USDA, 2015). In 2013, 37.7% of Americans report eating less than one serving of fruit daily and
22.6% report eating less than one serving of vegetables daily. The median intake of fruits is 1.1 servings and 1.6 servings of vegetables (National Center for Chronic Disease Prevention and Health Promotion, 2013). Vegetables contain many nutrients that are needed on a daily basis, including potassium, magnesium, folate, dietary fiber, and vitamins A, C and K. Two and half cups a day of fruits and vegetables have been associated with a decreased risk of developing cardiovascular disease and may prevent certain types of cancer (USDA & HHS, 2010). According to the American Heart Association (2014c), the recommended intake of fruits for females and males aged 11-14 is 1-1/2 cups to 2 cups per day (USDA, n.d. b). The recommended intake of vegetables is 2-3 cups per day (American Heart Association, 2014c).

Lorson, Melgar-Quinonez, and Taylor (2009) examined intake in U.S. children and found a trend in the most common fruits and vegetables that were consumed. One hundred percent fruit juice was the number one source of fruit. French fries made up almost half of the total vegetable intake compared to dark green and orange vegetables. (Lorson, Melgar-Quinonez & Taylor, 2009). According to the National School Lunch Program, juice cannot be offered more than half of the times other fruits are offered (USDA, 2012b). Other fruits and vegetables that are offered may increase the likelihood that students will take them. In a 2007 study, promoting and focusing on fruits and vegetables helps to increase the intake of middle school students (Cullen, et al., 2007).

Since fruit and vegetable intake is lower than the recommended intake on a daily basis, Harnack et al. (2012) studied intake in younger children and how to increase their
intake. They found that letting the children choose their own fruits and vegetables increased consumption; however, consumption included those foods that are sweet and salty. Vegetable intake did not differ much between the control and intervention groups because those foods were not as salty or sweet. Using dressing, cooking the vegetables, or using them in entrées increased vegetable intake (Harnack et al., 2012).

**Whole Grain Intake**

Among the American population, the intake of whole grains is relatively low, while the refined grains intake is high. It is important for Americans to have a high intake of whole grains and a lower intake of refined grains. The recommended amount of whole grains one should consume is three-ounce equivalents, and half of the total grains should be whole grain-rich. The average American eats less than one ounce-equivalent of whole grains a day (USDA & HHS, 2010). A child between the ages 10-14 should consume between 5 and 7 ounces of grains per day and should follow the guidelines of half of them being whole-grain (American Heart Association, 2014c; USDA, 2015; USDA, n.d. b).

Rosen, Sadeghi, Schroeder, Reicks, and Marquart (2008) found that elementary children consume more whole grains when it is gradually added to bread products. The white flour is slowly replaced by whole-wheat flour allowing for the adjustment to be easier. The whole grain-rich products are being under consumed and providing an easier way to increase intake is needed. Children adjust easier when serving the refined and enriched grains with whole grain-rich items (Rosen, et al., 2008; USDA, 2014a).
Sodium Intake

The majority of sodium intake comes from added salt to food preparation (USDA & HHS, 2010; American Heart Association, 2014a; CDC, 2014). Salt is commonly used in curing meat, baking, masking off flavors, retaining moisture, and enhancing flavor. According to a National Health and Nutrition Examination Survey (NHANES) in 2005-2006, the children aged 6-11 consumed approximately 3000 milligrams of sodium per day on average between females and males. The children aged 12-19 consumed approximately 4300 milligrams for males and 2900 milligrams for females. High sodium foods that are consumed at the highest rates include yeast breads, chicken and chicken dishes, pizza and pasta and pasta dishes, cold cuts and condiments (USDA & HHS, 2010).

Schools will be adjusting their recipes to follow the lower sodium regulation. According the NSLP, daily sodium cannot exceed 1360 milligrams for lunch and 600 milligrams for breakfast for middle school children (USDA, 2012b; USDA, 2012c). The sodium levels of the most popular foods will need to be adjusted to meet this new standard. In addition to breads, chicken dishes, pizza, pasta, deli meats and condiments, the sodium levels will also affect cheese, sausage and hot dogs (USDA, 2010a). Most of the sodium Americans consume in the diet comes from processed foods and restaurant foods (CDC, 2014; Whelton, et al., 2012). Sodium intake also comes from the added salt to foods after cooking. Just one teaspoon of salt equals 2300 milligrams of sodium. An individual’s sodium intake can increase twofold by just adding additional salt to already
prepared foods (American Heart Association, 2014b). The adequate intake for a middle school child is 1500 milligrams per day and the tolerable upper intake level is 2300 milligrams per day (USDA & HHS, 2010).

**Impact on School Food Service**

Schools are apprehensive about the new guidelines because the foods that abide by those regulations are not yet readily available in the marketplace or at a price point to fit within the school meal budgets. School directors are concerned that student participation in the National School Lunch Program may lower leading to a decrease in revenue. The new lower sodium foods and whole grain-rich foods may have a low acceptance rate from students. The school’s participation in purchasing competitive foods may also decrease after stricter rules are placed on them. Schools will have to buy more whole grain-rich products that are more expensive to produce and purchase (USDA, 2012b).

**Impact of New Guidelines on Students**

The new guidelines on fruits, vegetables, whole grain-rich products and the new sodium regulations have an impact on students and parents. Good habits of eating lower sodium foods can help decrease the risk for high blood pressure, and thereby reduce the risk for heart disease or stroke (USDA, 2010a; USDA, 2010b). The incorporation of more fruits, vegetables and whole-grain rich products also has good health benefits, such as prevention of certain cancers and heart disease (Van Duyn & Pivonka, 2000).
The acceptance of these new foods may be low, especially with the lower sodium foods, because individuals are used to eating higher sodium foods and it may take time for their taste perceptions to change to like the new lower sodium foods. Having the gradual change of lower sodium regulations across three target levels, years apart, is expected to help the students accept these new foods; however, student participation in the NSLP may decrease because of the new guidelines (USDA, 2012b).

**Behavior Change in Children**

Younger children are easier to influence than older children, especially when it comes to behavior changes. Younger children are easier to influence because many choices are made for them. It is critical for younger children to find their likes and dislikes, including their food preferences (O’Connell, Henderson, Luedicke, & Schwartz, 2012). Parents are the most influential people on his or her children’s food preferences. Parents are the role models to their children, as well as, the ones who introduce their children to new foods (Venter & Harris, 2009).

O’Connell, Henderson, Luedicke, and Schwartz (2012) state that repeated exposure of certain foods can increase the chance of the child liking that particular food. Wardle, Herrera, Cooke, and Gibson (2003) performed a study involving children looking at exposure and reward; therefore, repeated exposure to a particular vegetable increases the likelihood that the child will increase their consumption.

Wardle, et al. (2003) formed a study where children are introduced to red peppers as a way to show repeated exposure has an effect on the likelihood that the child will like
that vegetable. There are three groups: control, exposure, and reward. The children in each group were allowed to eat as much of the red pepper as they want, but the reward group only had to try one piece of red pepper in order to get a sticker. The exposure group had no reward, so the children did not have to hurry up eating and could eat as much as they want. This study was completed during a two-week (10-day) span and each day the children were exposed to the red pepper. Each child had the chance to eat as much as they could, where repeated exposure had a significant effect on consumption in the exposure group versus the other two groups (Wardle, et al., 2003). It is important for parents to continue exposure to some fruits and vegetables instead of giving up after a few times (O’Connell, et al. 2012).

Teachers also need to take responsibility as a role model for their students by practicing healthy eating. Arcan et al. (2013) performed a study as part of the Bright Start study looking at a teacher’s perceptions about the healthy eating practices and whether they serve candy as rewards for the children. This study involved kindergarten and first-grade students from 14 different schools among 75 teachers in an American Indian Reservation School District. Seven classes were the intervention groups and seven were the control groups. The intervention schools’ teachers were required to attend a two-day interactive in-service training over the importance of healthy eating and nonfood rewards.

To measure teacher classroom food-related practices and eating habits, a set of 15 items representing the teachers’ eating habits and classroom food and beverage practices
were placed into each classroom with a Likert scale survey on how often that particular food item or habit were used. This study assessed the teachers’ perceptions of school-wide food practices and policies, e.g. whether they use the vending machines on school property. Twenty-two items were placed in each classroom representing teacher beliefs of snack food and beverage practices and the influence it has on the school food environment. A Likert scale was also used for this measurement (Arcan, et al., 2013).

An intervention like this promotes the teachers to take a more active approach to become a healthy role model. The intervention teachers were given the adequate supplies and knowledge to teach their students what it means to be a healthy eater. The teachers in the control classrooms were given the adequate supplies and classes after the study was completed. The intervention classrooms found that the program was effective in decreasing the amount of candy used for rewards or incentives. The training these teachers received was effective (Arcan, et al., 2013). The emphasis on teaching healthy habits changes the behavior of the young students. It shows the students that there are many different ways that one can behave in a healthier manner and by not being rewarded with unhealthy options.

**Plate Waste Research**

Plate waste studies are helpful in measuring the amount of food that is wasted or consumed during a meal. They are popular in studies that look at fruit and vegetable consumption and in studies that analyze the cost of these food wastes (Cohen, Richardson, Austin, Economos & Rimm, 2013). Plate waste can be analyzed through
video recording and snapshots of the trays (Caine-Bish & Paranjape, 2014). Also, plate waste can be analyzed through weighing each food item before and after consumption (Cohen, Richardson, Parker, Catalano, & Rimm, 2014).

The reliability and validity of conducting a plate waste study varies with each method. Parent, Niezgoda, Keller, Chambers and Daly (2012) conducted a plate waste study using digital imaging and real time estimations. Comparing these two methods shows a strong correlation between the two. This means that digital imaging is effective enough to use instead of real time estimations. Hanks, Wansink, and Just (2014) found that the most effective way to analyze plate waste is the onsite visual quarter-waste method compared to the digital imaging method; however, they conclude that using the digital imaging method would be appropriate for finding differences in waste or consumption of unpackaged food.

**Study Purpose**

The Dietary Guidelines for Americans of 2010 states that the adequate intake of sodium for an adolescent to consume is 1500 milligrams per day. It is recommended that individuals, including adolescents, do not consume more than 2300 milligrams of sodium per day (USDA & HHS, 2010; Sebastian, R. S., Enns, C. W., Steinfeldt, L. C., Goldman, J. D., Moshfegh, A. J., 2013). Adolescents consume between 2900 and 4500 milligrams of sodium per day (USDA & HHS, 2010). It is important to regulate the sodium intake of adolescents to prevent the onset of heart disease and high blood pressure (USDA, 2010b; American Heart Association, 2011; Whelton et al., 2012). Providing healthier
meals to students is the aim of the National School Lunch Program’s new guidelines, including the guidelines specifying reduced sodium levels. Thus, the purpose of this study is to examine the consumption of foods typically associated with high sodium intake, and determine whether the new sodium regulations had an effect on the National School Lunch Program meal consumption in a Northeastern Ohio Middle School.
CHAPTER III

METHODOLOGY

Study Purpose

The purpose of this study is to examine the consumption of foods typically associated with high sodium intake, and determine whether the new sodium regulations had an effect on the National School Lunch Program meal consumption in a Northeastern Ohio Middle School.

Hypotheses

Using plate waste data from the current year and production record data comparing the 2013-2014 and 2014-2015 academic school years, our hypotheses include:

1. A significant decline is expected for the pizza stick consumption between data collection days 1, 2 and 3.
2. A significant decline is expected for the marinara sauce consumption served with pizza sticks between data collection days 1, 2, and 3.
3. A significant decline is expected between the sales (production data) of the pizza sticks and marinara sauce between data collection days 1, 2 and 3.
4. A significant decline is expected for the grilled cheese and tomato soup consumption between data collection days 1 and 3.
5. A significant decline is expected between the sales (production data) of the grilled cheese and tomato soup between days 1 and 3.
6. Based on a pre-test post-test plate waste design during the five-week menu cycle, no significant difference between genders on sodium consumption is expected.

7. Overall, food sales and production will be higher in the 2013-2014 academic school year as compared to the 2014-2015 academic school year when controlled for the amount of students who purchased lunch on a daily basis.

**Study Design**

This study was a mixed methods design involving both descriptive and comparative data analyses. A convenience sample has been used. The descriptive data described the frequencies for which foods are selected and eaten, as well as, the gender and grade level of the students and the day of data collection. The descriptive data collected also included the sales data and production record data. The comparative analysis examined the differences in the amount of food consumed using the before and after pictures of food on the lunch trays. In advance of data collection, the study protocol was approved by the Institutional Review Board.

**Study Site**

This study was conducted in a Northeastern Ohio school district composed of about 3,700 students across four elementary schools, one middle school, and one high school (ODE, 2015c). On a district level, the student body was made up of 72.9% White, non-Hispanic students, 12% Black, non-Hispanic students, 9.9% of multiracial students, 2.9% Hispanic students and 2.1% of Asian or Pacific Islander students. Among these
students, 14.2% were students with disabilities and 42.5% were economically disadvantaged (Ohio, 2014a).

Permission to conduct the study at this location was granted by the Principal and Vice Principal of the school and the Food Service Director and Assistant Food Service Director a month before data collection began (Appendix A).

Sample

The food trays of middle-school students were the focus of this study. The middle school is made up of the sixth, seventh, and eighth graders. Among the 741 students in the 2013-2014 school year, 330 (45%) receive free/reduced breakfast and lunch meals (Ohio, 2015c). At the beginning of the 2014-2015 school year, the average daily attendance is approximately 700 students. There are three lunch periods daily. Each lunch period serves one grade; in other words, the first lunch is sixth graders, the second is eighth graders and the third is seventh graders. The kitchen is divided between three lines. One line contains two hot lunch entrée and a pre-made salad bar. The second line is made up of a deli subs and a grab and go consisting of spicy chicken sandwiches and hamburgers. The third line is the pizza line that serves pizza, pizza sticks with marinara sauce and nachos. The sample for this study is the food trays of students who purchased a lunch and agreed to let their tray be photographed and recorded.
Study Procedures

FLOW CHART

Day One: Pizza Sticks with Marinara Sauce

Pre-food consumption photo

Grilled Cheese and Tomato Soup

Post-food consumption photo

Pre-food consumption photo

Day Two: Pizza Sticks with Marinara Sauce

Pre-food consumption photo

Post-food consumption photo

Post-food consumption photo
Day Two: Meatball Sub

Pre-food consumption photo

Post-food consumption photo

Day Three: Pizza Sticks with Marinara Sauce

Pre-food consumption photo

Post-food consumption photo

Grilled Cheese and Tomato Soup

Pre-food consumption photo

Post-food consumption photo
Day Three: Spaghetti and Meatballs

Figure 5. Procedure Diagram Listing A Pre and Post Consumption Photo of Each Entrée Served on Each Day.

Researchers

The researchers in this study took photographs of food trays before and after student consumption and made labels for each student’s tray. The matching of the before and after tray photographs was accomplished by labeling each tray with unique numbers and letters. Specific information about the camera and labeling procedures is given in the sections that follow.

Camera. Plate waste data was collected using the digital photography method. Two researchers operated the two cameras throughout each day. Two digital cameras and two tripods were used in data collection. The cameras used were SONY® HDR-CX210 digital cameras. The researchers set up two tables right outside the lunch lines in the cafeteria. The cameras were set up at the end of each table on a tripod. An empty
tray was used to mark the spot of where the students’ trays would be placed. The cameras were 11 inches above the empty trays at approximately a 45° angle as established by Caine-Bish and Paranjape (2014). The empty trays were taped to the table so that each tray would be photographed at the same distance and angle to facilitate the comparison of the before and after tray photographs.

The researchers who ran the cameras used SD cards to record the video and pictures. The cameras were set to record when the students started to exit the kitchen. The researchers asked the students for their trays, placed them on the sample tray and began taking pictures while recording. The cameras took a pre-consumption photo and a post-consumption photo of the food trays. The researchers only focused on the trays, not the students, and the camera record was only of the food tray.

**Tray labeling.** Researchers prepared a label to give to each student to identify their tray. As the students were coming into the kitchen to get their meals, the researchers asked the students for their birth date (month and day), their pod color, and assumed their gender. This labeling method provided unique codes to allow the matching of before and after tray photos while maintaining the anonymity of the student who had selected the foods. After eating, students left their trays on their tables while the labelers brought the post-consumption trays back to the two tables for the camera researchers to take a snapshot. One individual was also stationed at the trash area to retrieve trays of students who may have forgotten to leave the tray for the “post” photograph. The grade level of the students was not written on the post-it-note. Using time that each picture was
taken, the researcher determined the grade level of each student, since each lunch period only contained one grade.

Between the three days, the number of labelers ranged from two to four individuals. This process was repeated as students came and left for the three periods. This process was adapted from a study performed by Caine-Bish and Paranjape (2014).

**Researcher Interaction with Students**

Before entering the kitchen, the students were asked to provide the researchers their birth month, birth year and pod color. Pod color is the location of the school that students are placed for their classes. The students were told to keep the post-it-note with the trays and show it to the researchers on the cameras. The trays were placed on the tables outside the kitchen for the picture. The students were then asked to leave the trays on the table with their label. If a student did not want the tray photographed, they were allowed to bypass the cameras. A picture of the tray was not required for those students.

**Types of Data Collected**

Three types of data were collected in this study including the sodium content of the food served and consumed, sales records, and productions records.

**Sodium Data**

Since this study is focusing on the new sodium regulations, it is important to compare the sodium levels of the same meal from the previous year to the current year. On each entrée, the sodium level is calculated and written on its recipe. The sodium data was calculated using the NUTRIKIDS software, a program specifically designed for
menu planning and nutritional analysis. It is widely utilized across school districts across the country. NUTRIKIDS follows the USDA regulations and the Healthy, Hunger-Free Kids Act (“Menu”, 2014).

The recipes for each entrée were collected from the school food service director and assistant food service director in advance of the plate waste photographic data collection. The menu was examined for possible entrée choices that had a reduction in sodium. The plate waste measurement days were chosen by the days that the entrées were served. The entrée examined included pizza sticks with marinara sauce, grilled cheese and tomato soup, meatball sub, and spaghetti and meatballs. The 2013-2014 recipe for the pizza sticks with marinara sauce and the meatball sub was collected; however, 2013-2014 recipes for the spaghetti and meatballs and grilled cheese and tomato soup were not available. Recipes for all 2014-2015 entrées were collected.

The sodium content of each entrée was collected using the recipes from the 2014-2015 academic school year. The pizza sticks and marinara recipes were divided into two recipes. For two pizza sticks, the total sodium content is 440 milligrams. The no sodium added marinara, not served on the days of data collection in any of the entrées, has 20 milligrams of sodium. The ½ cup marinara sauce has 490 milligrams of sodium. The meatball sub contains a total of 939 milligrams of sodium. Dividing this into individual components, the ¼ cup marinara sauce served contains 245 milligrams of sodium; the meatballs contain 326 milligrams; the mozzarella cheese contains 105 milligrams; and the bun contains 263 milligrams of sodium. The grilled cheese sandwich contains 1251
milligrams of sodium and the tomato soup contains 484 milligrams. The spaghetti and meatballs contain 922 milligrams of sodium; the spaghetti contains 24 milligrams; the meatballs contain 408 milligrams of sodium and the marinara sauce, as served, contains 490 milligrams.

**Sales Data**

Sales data from the first five weeks of the 2013-2014 academic school year was compared to the sales data from the first five weeks of the school year 2014-2015. The sales data is collected and stored on the Point-of-Sale (POS) systems and each day’s sales records are printed out. It was collected from the food service director of the school district. The sales data consists of cashier reports. The cashier reports state the number of students, who purchase lunch, as well as, how many of those students receive free, reduced or full priced lunch. The total number of students who purchased lunch was used with the production record data to calculate the percentage of students who selected each entrée.

**Production Records**

Production records were collected for the first five weeks of the 2013-2014 school year and the first five weeks of the 2014-2015 academic school year. These records provided the opportunity to compare the production and sales of each entrée item between years, which then lead to our plate waste data collection. The production records are daily documents that show what foods were produced, leftover, and served. This document was used with the cashier reports to find a percentage of students who
purchased each entrée out of the total number of students who purchased lunch that day. The production records were collected from the assistant food service director.

Data Analysis

One researcher matched the pre- and post-food tray photographs by the data collection day and unique tray label. This researcher examined the pre- and post-waste photos to determine the percent of food consumption using a 10-percentage point scale ranging from 0% to 100% consumed. Because some of the entrées had multiple components, the consumption was assessed for each component independently. For example, each component of the meatball sub and spaghetti and meatballs was analyzed, as well as, the separate items including, pizza sticks, marinara sauce, grilled cheese and tomato soup. The assessment of consumption was recorded on an excel spreadsheet for each unique tray label and data collection day.

A second researcher examined every 6th tray, totaling 21 trays or 16.4% of all the trays and independently determined the percent consumed using the same 10-percentage point scale and method as the first researcher. This data was recorded on an excel spreadsheet also.

Using Cronbach’s Alpha, the statistician calculated the reliability statistic for each component (eleven total) in each entrée using the two amounts of consumption as decided by the researchers. Inter-rater reliability was considered good with a Cronbach’s alpha value of 0.86. An alpha of greater than 0.6 demonstrates good reliability (Pedhazur & Schmelkin, 1991).
The plate waste data were analyzed using independent t-tests and a one-way ANOVA. The frequencies and percentages of the demographic variables (gender, grade, day) were calculated. The maximum, minimum, mean and standard deviation of the sodium consumption levels was found by using the percentage consumed and the sodium content of the entrée components as determined by the analysis of the recipes using the NUTRIKIDS program. The one-way ANOVA was calculated comparing between groups and within groups. A statistical significance level is set at $p \leq 0.05$. The sales data and production records for the 2013-2014 and 2014-2015 academic years were analyzed using independent t-tests. Levene’s test was used with the independent t-tests to test for equality of variances.

**Inter-rater Reliability**

Cronbach’s alpha was calculated to test inter-rater reliability between the first researcher who assessed the percent of food consumption of all the trays ($n=128$), and a second researcher who examined 21 (16.4%) trays. In total, there were four entrées with a total of 11 components (e.g. pizza sticks and marinara sauce) that were assessed on the trays. For ten of the eleven ingredients, the Cronbach’s alpha value was 0.86 or greater. The meatball sub marinara sauce was the only ingredient that had a value less than 0.86. The Cronbach’s alpha of 0.75 for the meatball sub with marinara sauce is still evidence of high inter-rater reliability (IDRE, 2015). These results suggest a strong inter-rater reliability, which provides confidence in the ratings. Inter-rater reliability was used to provide evidence that the assessment of food consumption percentages were reliable.
CHAPTER IV

RESULTS

Plate waste data was collected on September 12, September 15, and September 26, 2014. Over these three days, 767 pre-food trays were photographed. In this study, all of the trays including the entrées of interest were selected and matched with a pre-food and post-food photo. There were 128 matched photos of the specific entrées used in this study. The other matched tray photographs, with foods not of interest for this study, were not included. Of the trays included in this study, 50 (39%) were pizza sticks and marinara, 36 (28%) were grilled cheese and tomato soup, 31 (25%) were meatball subs, and 11 (8%) were spaghetti and meatballs. The total number of students who purchased a lunch on data collection day 1, day 2, and day 3 was 372, 344, and 391 respectively.

Data was collected across a three-day period at the beginning of the school year and first five weeks of the menu cycle as a way to compare the differences in consumption between the first and second exposures to the students.

Demographic Frequencies

The demographic frequencies of the photographed middle school students’ trays are divided by gender, grade level, and day of data collection. The results are shown in Table 1. Slightly more trays of girls (54%) than boys were photographed. Most of the trays included in the study were from the sixth grade students (42%). Day two of the data collection had the greatest number of pre- and post-consumption trays (38%) photographed with the entrées of interest.
Table 1

*Demographic Frequencies of the Students Divided By Gender, Grade Level and Days of Study of Plate Waste Collection*

<table>
<thead>
<tr>
<th>Gender</th>
<th>n(^a)</th>
<th>Percent(^b)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boy</td>
<td>58</td>
<td>45.3</td>
</tr>
<tr>
<td>Girl</td>
<td>70</td>
<td>54.7</td>
</tr>
<tr>
<td>Total</td>
<td>128</td>
<td>100.0</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Grade Level</th>
<th>n(^a)</th>
<th>Percent(^b)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>54</td>
<td>42.2</td>
</tr>
<tr>
<td>7</td>
<td>31</td>
<td>24.2</td>
</tr>
<tr>
<td>8</td>
<td>43</td>
<td>33.6</td>
</tr>
<tr>
<td>Total</td>
<td>128</td>
<td>100.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Day</th>
<th>n(^a)</th>
<th>Percent(^b)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>37</td>
<td>28.9</td>
</tr>
<tr>
<td>2</td>
<td>49</td>
<td>38.3</td>
</tr>
<tr>
<td>3</td>
<td>42</td>
<td>32.8</td>
</tr>
<tr>
<td>Total</td>
<td>128</td>
<td>100.0</td>
</tr>
</tbody>
</table>

\(^a\)Number of students whose trays were photographed

\(^b\)Percentage of total students whose trays were photographed

**Entrée One: Pizza Sticks with Marinara Sauce**

The first entrée was composed of two pizza sticks and a one-half cup of marinara sauce. The pizza sticks are whole grain-rich breadsticks filled with cheese.

**Plate Waste**

Pizza sticks and marinara sauce were served on day one, two and three of data collection. Table 2 provides the mean percent of food consumption as assessed by pre- and post-consumption tray photographs. The mean sodium consumption based on the NUTRIKIDS recipe nutrient analysis and the mean percent consumed is also provided. Students generally ate most of the pizza sticks (95%), which are bread sticks with cheese.
in the interior. Consumption of the pizza sticks varied among students. Consumption of the pizza sticks ranged from 50% to 100%. If fully consumed, the sodium level for the pizza sticks would be 440 milligrams.

Consumption of the marinara sauce also varied among students. Overall, little (25%) of the marinara sauce was consumed. Some students ate zero percent of the marinara sauce, while one student ate one hundred percent. If a student fully consumes the marinara sauce, they would consume 490 milligrams of sodium for a total entrée sodium level of 930 milligrams. Using the mean consumption percentage, the sodium contribution of this entrée to the student’s daily intake was 540 milligrams.

A one-way ANOVA analysis of the consumption of pizza sticks and marinara sauce was conducted across the three days of data collection to examine if students changed their consumption over time because the pizza sticks were a different product than served the previous school year. The marinara sauce is the identical product used in previous years.

No significant difference was found for the marinara consumption between the days. A significant difference in consumption was found in the pizza sticks between the days with a p-value of 0.04. The descriptive data suggests that the difference was between day one and day two because it was the largest difference in mean consumption percentage between days. Students consumed less of the pizza sticks on day 1 as compared to day 2.
These results support the hypothesis of finding a significant decline between the pizza stick consumption. The results do not support the hypothesis of finding a significant decline between the marinara sauce consumption.

**Production Data**

There was no significant difference in the percent of students who purchased this entrée during the three days of data collection. The percent of students who purchased pizza sticks and marinara sauce on day 1, day 2, and day 3, was 13%, 15%, 13%, respectively. Because the school foodservice caps the total amount of production for this entrée each day, these results are expected.

There was a significant decline in the number of pizza sticks and marinara sauce purchased in the 2014-2015 school year as compared to the 2013-2014 school year. However, these results are not useful for this study because the amount of pizza sticks and marinara sauce produced and served in the 2014-2015 school year was capped at 52 servings, and was not capped in the previous year. Thus, the consumption was less during the current school year, but it is related to production decisions and not student preference in the selection of this entrée.

To control for enrollment of students in the fall, this study used the percent of students who purchased a specific entrée to the number of students who purchased a lunch. For example, on September 15, 52 students out of 344 purchased the pizza sticks and marinara sauce. These results do not support the hypothesis of finding a significant difference between the sales of the pizza sticks and marinara sauce between the three
days of data collection. However, as explained, the amount sold was also impacted by
the school’s control of how much would be produced each day.

**Entrée Two: Grilled Cheese and Tomato Soup**

The second entrée was a grilled cheese sandwich consisting of two ounces of
American cheese and two slices of whole grain-rich bread. The tomato soup was
prepared from canned tomato soup.

**Plate Waste**

Grilled cheese and tomato soup was served on day one and three of data
collection. An independent t-test was utilized to see whether there was a significant
difference in consumption between the two days. Plate waste data was collected on 25
trays on the first day and 11 on the third day of collection. The mean percent consumed
of the grilled cheese sandwich was 84%. The mean percent consumption was not
significantly different between the two days of data collection. For data collection days
one and three, the percent consumed of the grilled cheese sandwich was 85% and 83%
respectively. This makes the mean sodium consumption on day one and three equal 1063
and 1038 milligrams, respectively. Consumption of the grilled cheese ranged from ten
percent to 100 percent. If fully consumed, the total sodium consumed was 1251
milligrams.

The mean consumption of the tomato soup was 49%. An independent t-test found
there was no significant difference in consumption between the two days of data
collection. On day one, 25 matched pre-and post-consumption trays were examined, and
on day three, 11 trays were assessed. The mean sodium consumption for the tomato soup on day one was 222 and on day three it was 271 milligrams. Consumption of the tomato soup ranged from 0 to 100%. If fully consumed, the total sodium consumed was 484 milligrams. A total average sodium consumption of both of these items contributes 1288 milligrams. These results do not support the hypothesis that a significant decline was found for the grilled cheese and tomato soup consumption from day one to day three.

**Production Data**

The grilled cheese and tomato soup was served five times during the first five weeks of the 2013-2014 academic year and only two times during the first five weeks of the 2014-2015 academic year. The percent of grilled cheese and tomato soup that was purchased in 2013 was 12% and during 2014, the amount of students who purchased this entrée was 16%. The t-test showed no significant difference between the years.

Using an independent t-test, this study examined whether there was a difference in students purchasing these entrées during the two days of data collection. The percent of students who purchased this entrée during the two days it was served decreased but not significantly. On the first day, 17% purchased the grilled cheese and tomato soup and on the third day, 13% purchased this entrée based on the total number of students who purchased lunch being 372 and 391, respectively. These results do not support the hypothesis that a significant decline was found for the sales of the grilled cheese and tomato soup between the two days of consumption.
**Entrée Three: Meatball Sub**

The third entrée was the meatball sub, which is made up of four meatballs, marinara sauce, mozzarella cheese and a whole grain-rich bun.

**Plate Waste**

Meatball subs were served only on day two of data collection. A t-test was calculated to evaluate whether there was a significant difference of consumption based on gender. There was no significant difference between genders on the consumption of this entrée. Thirty-one trays were collected of the meatball subs. The consumption of the marinara sauce ranged from 20% to 100%. The consumption of the meatballs ranged from 50% to 100%. The consumption of the mozzarella cheese ranged from 0% to 100%. The bread consumption ranged from 0% to 100%.

The average consumption of the marinara sauce was 85.5%, making the average sodium consumption 209 milligrams. The average consumption of the meatballs was 93.2%, making the average sodium consumption 306 milligrams. The average consumption of the mozzarella cheese was 85.2%, making the average sodium consumption 90 milligrams. The average consumption of the bread was 68.1%, making the average sodium consumption 179 milligrams. Overall, the total average consumption of the meatball sub is 784 milligrams of sodium. If the meatball sub was completely eaten, the sodium consumption was 939 milligrams.
Production Data

The meatball subs were served once in 2013 and twice in 2014 during the five-week menu cycle. In 2013, the mean percentage of students purchasing meatball subs was 27. In 2014, the mean percentage was 17. Fewer students purchased the meatball sub this year compared to last year, but it was not significant with a p-value of 0.53.

Entrée Four: Spaghetti and Meatballs

The fourth entrée was spaghetti and meatballs. This entrée is composed of five meatballs, whole grain-rich spaghetti and marinara sauce.

Plate Waste

Spaghetti and meatballs were served only on day three of data collection. The spaghetti and meatballs was divided up into ingredients during the plate waste analysis. This included the spaghetti, meatballs, and sauce. The independent variable for this data was gender. There was no significant difference between the food consumption of boys or girls of these three ingredients and overall entrée.

On this day of data collection, only 20 servings were served because it was a leftover product. However, 11 pre-and post-trays with this entry were photographed on this day. The percent of consumption of the spaghetti ranged from 0% to 100% with an average percent consumption 83%, making the average sodium consumption 20 milligrams. The percent of consumption of the meatballs ranged from 0% to 100% with an average percent consumption of 67%, making the average sodium consumption 273 milligrams. The percent of consumption of the marinara sauce ranged from 0% to 100%
with an average percent consumption of 67%, making the average sodium consumption of 328 milligrams. Using the average total sodium consumption of this entrée, a student consumed 621 milligrams of sodium. The total possible sodium consumption associated with this entrée is 922 milligrams.

**Production Data**

The spaghetti and meatballs was served once in 2013 and twice in 2014 during the first five-week menu cycle. In 2013, the mean percentage of students who purchased this meal was 23 and in 2014, the mean percentage was 12. Fewer students purchased the spaghetti and meatballs this year compared to last year and it was a significant difference with a p-value of 0.002; however, this is attributed to only having one day of serving spaghetti and meatballs in 2013.

Table 2

*Total Percent of Mean Consumption of Entrées that were Served on Two or More Days of Data Collection and Sodium Consumption of Those Entrées*

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>Mg of sodium per item as served</th>
<th>Mean % Consumed&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Std. Deviation</th>
<th>Mean Sodium Consumed (mg)&lt;sup&gt;b&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pizza Sticks</td>
<td>50</td>
<td>440</td>
<td>95</td>
<td>13</td>
<td>418</td>
</tr>
<tr>
<td>Marinara</td>
<td>48</td>
<td>490</td>
<td>25</td>
<td>21</td>
<td>123</td>
</tr>
<tr>
<td>Grilled cheese</td>
<td>36</td>
<td>1251</td>
<td>84</td>
<td>26</td>
<td>1050</td>
</tr>
<tr>
<td>Tomato Soup</td>
<td>36</td>
<td>484</td>
<td>49</td>
<td>45</td>
<td>237</td>
</tr>
</tbody>
</table>

<sup>a</sup>Mean consumption was determined by assessing percent of food consumed through photographs of pre- and post-consumption trays using a 10 point scale ranging from 0 consumed to 100 percent consumed.

<sup>b</sup>Measured in milligrams, sodium consumption calculated using NUTRIKIDS recipe analysis per portion and then multiplying by the mean percent consumption.
Gender

The consumption by gender was calculated by entrée and total sodium consumption across the three days. Boys consumed more sodium than girls, but the difference was not significant. The p-value was 0.45. The mean sodium consumption in boys was 845 milligrams. The mean sodium consumption in girls was 789 milligrams. There was no significant difference between genders for any of entrées examined in this study. The maximum sodium consumption was 1735 milligrams, the minimum was zero milligrams and the mean was 814 milligrams. The hypothesis that there was no significant difference between genders on sodium consumption was proven correctly making that boys and girls do not consume significantly different amounts of sodium.

Overall Production Data

Levene’s test was significant; therefore, equal variances were not assumed. The t-test used the production data from each year to find the sales during the first five weeks of the 2013-2014 and 2014-2015 academic years were not significantly different ($p = 0.12$). There were fewer students who purchased these entrées in the academic year 2013-2014 compared to academic 2014-2015 year, using the mean percentage of students who purchased each entrée. Although sales of these entrées were higher in 2013-2014 academic school year (20.1%) as compared to 2014-2015 (13.6%), the differences were not found to be significantly different ($p = 0.12$); therefore, this hypothesis was not proven.
Typical Tray with Full Sodium Content

Under the National School Lunch Program, a student selecting a reimbursable lunch will be offered two vegetables, one fruit, one entrée, and a half-pint of milk for their meal. These components make up a typical tray. Every student is allowed to take condiments with their meal as well.

Entrée One: Pizza Sticks with Marinara Sauce

A student who chose the pizza sticks with marinara sauce on September 26 could take one vegetable, one fruit, and a milk to complete their lunch, since the ½ cup of marinara sauce counts as a vegetable. On the day that photos were taken, students could potentially select French fries, an orange, a half-pint of chocolate milk and two ranch packets. The portion sizes and sodium content of each meal component is shown in Table 3. The total milligrams of sodium for the whole tray, if a student picked all items and consumed the average consumption of each entrée, would equal 1056 milligrams. If a student consumed 100% of all components, the consumption would be 1445 milligrams of sodium.

Entrée Two: Grilled Cheese and Tomato Soup

A student who chose the grilled cheese and tomato soup entrée could consume two vegetables, one fruit, and a half-pint of milk with their meal. Grilled cheese and tomato soup was served on two of the data collection days: September 12 and 26. A student on one of these two days could potentially choose the strawberries, corn, salad, a half-pint of chocolate milk, and two ranch packets with their meal. Using Table 3 and the
average sodium consumption for the entrées, the total amount of sodium for this particular meal is 1868 milligrams. If a student consumed 100% of all components of this meal, the consumption would be 2316 milligrams of sodium.

**Entrée Three: Meatball Sub**

Meatball subs were served on September 15. The vegetable options for this day of collection included tater tots and carrots. The fruit choice was pineapple chunks. A student could also take a half-pint of chocolate milk and two packets of ranch dressing. Using Table 3 and the average consumption of each component, the total sodium for this meal is 1513 milligrams. If the whole meal was consumed, the consumption would be 1666 milligrams of sodium.

**Entrée Four: Spaghetti and Meatballs**

Plate waste for the spaghetti and meatballs was collected on September 26. The vegetables for this day consisted of fresh broccoli and romaine mix salad. Pears were served as the fruit. A student could take a half-pint of chocolate milk and two Italian dressing packets. Using Table 3, this tray contains 1078 milligrams of sodium as a whole. If 100% of the entrée was consumed along with the other components, the total amount of sodium consumed would be 1365 milligrams.
Table 3

Breakdown of Each Typical Meal with Portion Sizes, Sodium Levels per Portion, Percent of Consumption and Sodium Consumption

<table>
<thead>
<tr>
<th>Entrée Items</th>
<th>Portion</th>
<th>Milligrams$^a$ of sodium per portion</th>
<th>% of Consumption$^b$</th>
<th>Sodium Consumption$^c$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Entrée Item</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pizza sticks</td>
<td>2 sticks</td>
<td>440</td>
<td>95</td>
<td>418</td>
</tr>
<tr>
<td>Marinara</td>
<td>½ cup</td>
<td>490</td>
<td>25</td>
<td>123</td>
</tr>
<tr>
<td>Grilled Cheese</td>
<td>1 sandwich</td>
<td>1251</td>
<td>84</td>
<td>1050</td>
</tr>
<tr>
<td>Tomato Soup</td>
<td>½ cup</td>
<td>484</td>
<td>49</td>
<td>237</td>
</tr>
<tr>
<td><strong>Meatball sub</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marinara</td>
<td>¼ cup</td>
<td>245</td>
<td>86</td>
<td>211</td>
</tr>
<tr>
<td>Meatballs</td>
<td>4 meatballs</td>
<td>326</td>
<td>94</td>
<td>306</td>
</tr>
<tr>
<td>Mozzarella</td>
<td>½ oz</td>
<td>105</td>
<td>86</td>
<td>90</td>
</tr>
<tr>
<td>Bread</td>
<td>1 bun</td>
<td>263</td>
<td>68</td>
<td>179</td>
</tr>
<tr>
<td><strong>Spaghetti and Meatballs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spaghetti</td>
<td>1 cup</td>
<td>24</td>
<td>82</td>
<td>20</td>
</tr>
<tr>
<td>Meatballs</td>
<td>5 meatballs</td>
<td>408</td>
<td>68</td>
<td>277</td>
</tr>
<tr>
<td>Sauce</td>
<td>½ cup</td>
<td>490</td>
<td>69</td>
<td>338</td>
</tr>
<tr>
<td><strong>Vegetables$^d$</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>French Fries</td>
<td>½ cup</td>
<td>125</td>
<td></td>
<td>125</td>
</tr>
<tr>
<td>Romaine Salad</td>
<td>1 cup</td>
<td>12</td>
<td></td>
<td>12</td>
</tr>
<tr>
<td>Corn</td>
<td>½ cup</td>
<td>177</td>
<td></td>
<td>177</td>
</tr>
<tr>
<td>Carrots</td>
<td>½ cup</td>
<td>55</td>
<td></td>
<td>55</td>
</tr>
<tr>
<td>Tater tots</td>
<td>½ cup</td>
<td>282</td>
<td></td>
<td>282</td>
</tr>
<tr>
<td>Broccoli</td>
<td>½ cup</td>
<td>11</td>
<td></td>
<td>11</td>
</tr>
<tr>
<td><strong>Fruit$^d$</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Orange</td>
<td>1</td>
<td>0</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Strawberries$^e$</td>
<td>½ cup</td>
<td>2</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Pineapples</td>
<td>½ cup</td>
<td>0</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Pears</td>
<td>½ cup</td>
<td>10</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td><strong>Milk$^d$</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>1 half-pint</td>
<td>108</td>
<td></td>
<td>108</td>
</tr>
<tr>
<td>Chocolate</td>
<td>200</td>
<td></td>
<td></td>
<td>200</td>
</tr>
<tr>
<td>Strawberry</td>
<td>125</td>
<td></td>
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<td>125</td>
</tr>
<tr>
<td>Skim</td>
<td>103</td>
<td></td>
<td></td>
<td>103</td>
</tr>
<tr>
<td><strong>Dressing$^d$</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ranch</td>
<td>1 packet</td>
<td>95</td>
<td></td>
<td>95</td>
</tr>
<tr>
<td>Italian</td>
<td>1 packet</td>
<td>105</td>
<td></td>
<td>105</td>
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</tbody>
</table>

$^a$Milligrams of sodium per portion derived from NUTRIKIDS recipes
$^b$Mean consumption was determined by assessing percent of food consumed through photographs of pre- and post-consumption trays using a 10 point scale ranging from 0 consumed to 100 percent consumed.
$^c$Sodium consumption calculated by multiplying the percent consumed by the total milligrams
$^d$Consumption not measured, therefore sodium for these items calculated based on the potential of 100% consumption
$^e$Source: Strawberries, SelfNutritionData, 2014
CHAPTER V

DISCUSSION

This study was conducted with the primary purpose of analyzing how the new sodium guidelines would affect sodium consumption because tomato products are known to have added sodium. These tomato products were examined with the belief that the sodium decreased. The recipes examined for this study identify that a No Sodium Added (NSA) marinara sauce was being used.

During analysis of the data, one researcher realized that the correct marinara sauce was not being purchased and implemented into these meals; instead the previous marinara sauce was being used. The sodium difference between these two sauces is 470 milligrams of sodium. Consequently, the researchers were unable to examine the consumption of a lower sodium product as planned. Through this process, the researchers found the importance of a connection between management and kitchen personnel to make sure that new products are being ordered and used. Breakdowns in communication can occur, which then impact the ability to make desired changes. The lack of strict adherence to recipes is a common concern in a wide number of foodservice operations.

Thus, with no change in the sodium levels of the tomato products as actually served, few significant results were found in the plate waste data collection. The entrées chosen and analyzed in this study were selected based on the knowledge that processed tomato products are high in sodium and a sodium reduction from the previous year was
expected in light of the new recipe planned for the 2014-2015 academic year.

Additionally these entrées, pizza sticks and marinara sauce, grilled cheese with tomato soup, meatball sub, and spaghetti and meatballs are popular meal choices among the students. Vegetables, including tomatoes, are considered to be healthy choices that are low in calories and sodium, and are high in fiber. Guthrie and Lin (2014) found that vegetables are often served in ways that add calories, fat, and sodium. These researchers reported that canned tomato sauce could contain as much as 1000 milligrams of sodium per cup, while a raw tomato has nine milligrams of sodium (Guthrie & Lin, 2014). In this study, the marinara sauce serving had 490 milligrams in ½ cup, while in the NSA marinara sauce has 20 milligrams of sodium per ½ cup serving. The higher sodium marinara sauce was being served at the time of the pre- and post-consumption trays were photographed even though the recipe specified the NSA marinara sauce.

As part of a reimbursable meal, a student can take two vegetables, one fruit, a half-pint of milk, and an entrée. Each entrée’s sodium content and the sodium content of each vegetable served on the days of data collection, a total amount possible of sodium consumption one student can consume can be calculated. As presented in the results, a student could consume 1445 milligrams if they took the pizza sticks and marinara sauce, one vegetable, one fruit, a half-pint of milk and two dressing packets and ate all of it. The meatball sub complete meal contains 1666 milligrams of sodium and the spaghetti and meatballs meal contain 1365 milligrams of sodium. According to the new sodium regulations, a lunch meal should be equal to or less than 1360 milligrams of sodium.
(USDA, 2012b; USDA, 2012c). Zero of these entrées met the sodium target for the entire meal, if consumed.

The pizza sticks and marinara sauce is too high in sodium in relationship to the current sodium guidelines for schools participating in the National School Lunch Program. This could be attributed to the fact that the marinara sauce never changed. The pizza sticks were the only item that changed between years. The product became whole grain and switched to a different manufacturer. It is also the only item that showed a significant difference between days in percent of consumption. The pizza sticks were switched to a more whole grain and lower sodium product to follow the new guidelines of making all grains be more than half whole grain (USDA, 2012b; USDA, 2014a). It is interesting to note that even though the pizza sticks were the one item that changed, both lower sodium and more whole grain, it was the product that had the highest consumption at 95% consumed.

The grilled cheese with tomato soup entrée and meatball sub do not meet the new the sodium regulations because they contain more than 1360 milligrams of sodium. The meatball sub has 1666 milligrams of sodium. If menu sodium levels are evaluated over a full week, these higher sodium menus could still fit within a week if lower sodium menus are served on other days.

The spaghetti and meatballs meal also does not qualify as meeting the new guidelines with a sodium amount of 1365. It is just over the sodium target. This meal
did change to address new national school lunch guidelines in 2014-2015 with regard to the whole grains by serving whole grain spaghetti.

The grilled cheese and tomato soup alone has 1735 milligrams of sodium. With the other components, the meal (based on mean percent consumption) contains 2316 milligrams of sodium. To note, the grilled cheese sandwich is made with five slices of American cheese, each at 0.4 oz, to meet the two-ounce meat regulation per entrée for middle school students. The American cheese is high in sodium, but also provides calcium and Vitamin D that is helpful in making an adolescent’s bones strong and healthy, especially during the second largest growth spurt (Harkness & Bonny, 2005).

If the school stops serving the grilled cheese because of its high sodium content in large part because of the amount of cheese necessary to meet the two-ounce meat menu component, it raises the challenge to school officials and the Federal government (i.e. USDA) to decide whether the higher sodium levels are of more concern than calcium intake. Some children may not consume milk, but do consume the grilled cheese. The grilled cheese could provide that student with the calcium and Vitamin D to fight off the potential of getting osteoporosis later in life.

In addition to these meals, students are able to take as many condiments as they want. Throughout data collection, ketchup and barbecue sauce were the only controlled condiments, where students could only have three packets combined. The other condiments, such as ranch dressing, Italian dressing or mayonnaise are not controlled and a student could take as many ranch packets as they pleased. The condiments are not
controlled as much as they potentially should be in light of their contributions to sodium intake. These condiments can add enough sodium to push the sodium level of the tray over 1360 milligrams.

The excess sodium in each of these meals adds to the daily amount an adolescent consumes on a daily basis. The Dietary Guidelines for Americans of 2010 recommends that Americans consume less than 2300 milligrams of sodium and the adequate intake is 1500 milligrams of sodium (USDA & HHS, 2010). Adolescents are consuming too much sodium and it is a concern to their health (Story & Stang, 2005). As the National School Lunch Program lines up the sodium regulations to decrease again in 2017-2018 and 2022-2023, the sodium intake of adolescents will decrease in the school cafeteria.

The entrées in this study presented little change with the sodium regulations in spite of a higher sodium marinara being served than originally planned. All the entrées as served, except the grilled cheese and tomato soup, were reasonably within range of the 1360 milligrams of sodium being at 930, 939 and 922 for the pizza sticks with marinara sauce, meatball sub, spaghetti and meatballs respectively. The students did not show any significant consumption difference with these entrées, with the exception of the pizza sticks. This could be attributed to the fact that the recipes did not change between the two years.

The grilled cheese and tomato soup meal had a total possible sodium consumption of 2316 milligrams of sodium. Meals that continue to be between 1500-2300 milligrams exceed the adequate intake or dietary recommended intake for sodium before the other
meals consumed during the day are accounted for. In adolescence, a higher sodium diet can onset the likelihood of developing high blood pressure, heart disease, heart attack, and stroke (USDA, 2010b; American Heart Association, 2011; Whelton et al., 2012).

Each entrée can be compared to the current regulation of 1360 milligrams of sodium. The grilled cheese and tomato soup contain 1735 milligrams of sodium, which is 128% of the current regulation. The pizza sticks and marinara sauce contains 930 milligrams, which is 68% of the regulation. The meatball sub contains 939 milligrams, which is 69% of the regulation and the spaghetti and meatballs contains 922, which is 68% of the sodium regulation. These sodium amounts are for the entrées alone, and the additional food components will contribute further to the total sodium content of the meal.

The grilled cheese and tomato soup was the one entrée that exceeded the target sodium level of 1360 milligrams with 1735. All the other entrées were 939 milligrams or fewer. The grilled cheese and tomato soup was also the second most popular item with a purchased rate of 16% behind the meatball subs with a purchased rate of 17% using the production and sales data. The pizza sticks and marinara sauce was the third most popular item with a purchased rate of 13.7%; however, this was the capped entrée at only serving a maximum of 52 servings, so it may have been the most popular item among the four entrées. The spaghetti and meatballs was the least popular with a purchase rate of 12%.
The 8-ounce serving of non-fat milk, included as part of the lunch, contains between 103-200 milligrams of sodium depending on what flavor of milk one chooses. The chocolate milk contains 200 milligrams, followed by the strawberry milk at 125 milligrams, then the white milk at 108 milligrams and the skim milk at 103 milligrams. The milk consumption contributes approximately 7.5% to 14.7% of the total 1360 milligrams regulation. When the sodium regulations become stricter in the 2017-2018 academic school year and the 2022-2023 academic school year with a sodium regulation of 1035 and 710, the milk alone will contribute 10-20% and 14.5-28.2%, respectively of the total sodium content of the meal. With milk as a component of the school lunch menu because of its contribution in diets to the calcium and vitamin D needs, the entrée served will need to be much lower in sodium when these new lower sodium guidelines take effect because the amount of sodium in the milk will remained fixed.

Challenges are expected for school foodservice programs when more stringent sodium requirements take effect. Recipes can be revised to use new lower sodium products, and foods may be prepared with more seasoning and spices in place of salt (USDA & HHS, 2010). Implementation of these changes will need to include all members of the foodservice team so everyone is informed about the ingredient and recipe changes.

Lower sodium products can be incorporated in to the recipes to help keep the sodium levels of the overall meal under the target level (USDA & HHS, 2010). Since the
grilled cheese and tomato soup entrée alone exceeded the target sodium level, a lower sodium tomato soup may be incorporated into the recipe.

**Limitations**

A few limitations exist in this study. First, the recipes of each entrée were used to find the sodium content of each entrée and to compare the sodium levels between the 2013 recipes and 2014 recipes. Only two recipes were gathered that had a comparison recipe from the previous year. These recipes included the pizza sticks and marinara sauce and the meatball sub. The recipes for the spaghetti and meatballs and grilled cheese with tomato soup were not collected because the old recipes had not been retained, so no comparison among sodium levels existed.

Second, the study’s intention was to collect plate waste data on four days during the time period; however, due to unexpected unavailability of volunteers, one day was cancelled. This cancelled data collection day would have provided the second day of meatball subs and the first day of spaghetti and meatballs. With this day cancelled, only one day of data collection existed with these entrées making the entrées incomparable between days.

Third, the expectation that the recipes changed between years did not occur. Most of the entrées analyzed saw little to no change in sodium content between years because of the use of the standard marinara sauce. However, in spite of the use of the regular, and not NSA marinara sauces, several of the entrées with marinara already fell into the acceptable category for sodium level.
Fourth, the pizza sticks and marinara sauce recipe calls for a new marinara sauce that contains no salt added (NSA); however, through discussions with food service personnel, the marinara sauce did not change. Identical marinara sauce was used in 2013-2014 and 2014-2015 academic years.

**Implications and Future Research**

One implication from this study is for food service managers to realize that disconnect between manager and food service workers can easily occur. This is a real world environment within a critical time period among new regulations. Managers should be seeking to make changes and make that connection. The whole food service system, especially within a school district, needs to be examined whenever major changes occur in menu regulations or other policies. Every aspect needs to be examined and communicated. School foodservices have a wide variety of regulations to follow, and when significant changes occur, difficulties can be evident during the transitional stage.

Good record keeping whenever changes are made or planned is important. Some of the older production records were not retained in study, and the recipes were not able to be compared between years. Maintaining good records allows for comparison of recipes between years, especially with the nutrition facts for the sodium levels. Good record keeping with the orders and recipes will help to ensure the ingredients used are matching up with plans.

As difficulties arise in meeting the new guidelines, some food service directors and school personnel may feel it is too difficult to continue in the National School Lunch
Program. These school food service directors may find it easier to discontinue participation in the school lunch program, and to seek other ways of producing the necessary revenue to still provide free, or reduced price meals while also offering economical full-priced meals. For schools who continue in the school lunch program and yet have difficulties following the new regulations, the government is faced with how to influence these school districts to better comply with the guidelines.

Food service directors will have to make hard choices, with both the menu planning and ordering. Issues such as how food service managers will balance foods with higher sodium when those foods, i.e. the grilled cheese, have other positive attributes like the dairy and protein.

As the regulations decrease with the next two sodium target levels, it will be interesting to see what and how much the students will consume because these entrées are likely not to be the same taste when the school lunch target sodium level is 1035 and 710 milligrams. The sodium content of the other lunch components such as vegetables, fruit, milk and condiments will need to be taken into account. School food service directors who to continue in the National School Lunch Program should be aware of the amount of sodium that a whole meal contains to avoid going over the maximum sodium target level. Future research could include looking at the other parts of the meal and their effect on sodium intake or whole-grain intake. This study could be replicated when the next two sodium target levels of the NSLP are implemented.
Future studies looking at ages of all students and their sodium consumption levels could be investigated. The preferences of older students could be different than the younger students; therefore, the results could provide insight on whether the younger students prefer the lower sodium foods.

Using the method of digital photography to measure plate waste is an effective measurement in this study. The reliability using Cronbach’s alpha exceeded 0.86 on ten of the eleven components with one component at 0.75, which still shows good reliability.

**Conclusion**

The challenges of food service directors and their ability to follow, keep up with the new guidelines and relay those guidelines to employees is the main finding coming out of this study. The pizza sticks were the only product that actually changed from the previous year. It became lower sodium and more whole grain, and was the only product that showed a significant decline in consumption between days of data collection. The use of the correct marinara sauce, as specified on the recipe, could have shown a significant result in the consumption of these entrées if it had been used. The new sodium target levels will prove to be difficult to follow and food service directors will have to focus on new ways to incorporate and promote the lower sodium foods into the menus to help reduce the adverse health effects a high sodium diet can have on a child later in life.
APPENDIX
APPENDIX A

LETTER OF CONSENT
Appendix A
Letter of Consent

August 25, 2014

Barbara Retzer, Master’s Student at Kent State University and employee of __________ has permission to collect data at ______________ during four lunch periods in September / October 2014 following approval by the Kent State University Institutional Review Board (IRB) of her research protocol. The research methodology was approved by Barbara Retzer’s thesis committee on August 22, 2014. Assisting Barbara Retzer with data collection will be Kent State University Faculty and graduate students.

Her data collection will include video/photo recording lunch trays before and after consumption to examine plate waste of selected foods. Lunch trays will be labeled with student birth day and month (but not year), and color of pod within school. No student names or other information will be collected from students. This portion of the study is only examining food waste through before and after video and photography. Additionally, sales and food production data of academic year 2013/2014 and fall 2014 will be shared.

The purpose of the study is to examine the impact of new sodium guidelines for school lunches on plate waste and sales. Results of this study will be shared with __________ food service director.

X_________________________________  X____________________
(Type in Name of Director Here)           Date
REFERENCES


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