The Association Between Time to Eat and Students Fruit & Vegetable Consumption, Selection, and Waste

by

Christina Marie Dandridge

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Graduate Supervisory Committee:

Marc Adams, Chair  
Corrie Whisner   
Meg Bruening

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Abstract

Background: Studies have examined student fruit/vegetable (FV) consumption, selection, and waste related to lunch duration and found that longer duration at lunch was associated with greater consumption, selection, and reduced waste. However, few studies have investigated the relationship between time to eat and FVs. The aim of this research is to analyze the relationship between objective time to students took to eat (“time to eat”) as it relates to their fruit and vegetable consumption, selection, and plate waste.in elementary, middle, and high schools.

Methods: A secondary analysis of cross-sectional study of 37 Arizona schools to discover the differences in the selection, consumption, and waste of FVs from students (Full N = 2226, Elementary N = 630, Middle School N = 699, High School N = 897) using objective time to eat measures. Zero-inflated negative binomial regressions examined differences in FV grams selected, consumed, and wasted adjusted for sociodemographics including race, ethnicity, eligibility for free or reduced lunch, academic year, and sex. . Results are presented across school level (elementary, middle, and high school).

Results: It was discovered that elementary and middle school students took longer to eat their meals compared to high school students. In the count model for every additional minute spent, there was a 0.5% greater likelihood of selecting FVs for elementary kids among those who took any FVs. The results indicated that the longer students took to eat, the higher the likelihood of consuming more grams of FVs. Time to eat was related to increased FV consumption. Each 10 more minutes spent eating (i.e., time to eat) is associated with a 5% increase in grams of FV selected relative to mean (for those that chose F/V) over 1 week this equates to 32 g increase of F/V selected. Time to eat was not statistically related to the grams of FV wasted among students who wasted some FVs (IRR=0.997; p=0.292.). However, there was some significance in the sociodemographic factors such as gender (all) and other (middle school) .

Conclusions: Given that our data showed no association between lunch duration and eating time, future research should concentrate on these topics. There are many barriers to eating fruits and vegetables that have been found. Interventions and/or school policies could be put in place that encourage increased student choice and consumption of fruits and vegetables while reducing waste at lunch.Table of Contents

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CHAPTER 1

INTRODUCTION

**Overview**

“Schools are essential to early exposure to good nutrition and provide a blueprint for healthy eating that can last a lifetime,” said USDA Under Secretary for Food, Nutrition and Consumer Services Kevin Concannon. According to the latest Vital Signs report from the Centers for Disease Control and Prevention, children aged 2 to 18 in the United States are consuming more whole fruit (CDC, 2019). The quantity of whole fruit consumed daily increased by 67 percent between 2003 and 2010, but remains low (CDC, 2019). Despite these gains in fruit consumption, children continue to fall short of the daily FV consumption recommendations (CDC, 2019). In 2007-2010, 60% of children did not consume enough fruit to satisfy daily recommendations, and 93% of children did not consume enough vegetables (CDC, 2019). Obesity, hypertension, coronary heart disease, stroke, and cancer have all been associated with a poor intake of fruits and vegetables (Slavin & Lloyd, 2012). Low consumption of fruits and vegetables and the associated chronic diseases are caused by a variety of variables (CDC, 2019). The amount of fruit and vegetables that children should consume is determined by their age, gender, and degree of physical activity (CDC, 2019). Girls ages 9-13 years need to eat 1 ½ cups of fruit and 2 cups of vegetables daily (DGA, 2020). Girls ages 14-18 years need to eat 1 ½ cups of fruit and 2 ½ cups of vegetables daily (DGA, 2020). Boys ages 9-13 years need to eat 1 ½ cups of fruit and 2 ½ cups of vegetables daily (DGA, 2020). Boys ages 14-18 years need to eat 2 cups of fruit and 3 cups of vegetables daily (DGA, 2020). These amounts are for children who get less than 30 min/day of moderate physical activity, beyond normal daily activities (DGA, 2020). More active children may be able to consume more while staying within calorie needs (DGA, 2020). Good nutrition and a healthy lifestyle are essential for a child's overall success and readiness to learn.

An effective approach for assisting students in achieving their maximum academic potential and enhancing their general health and wellbeing is by creating a positive school meal environment, which includes giving them enough time to eat after receiving their meal (CDE, 2022). According to studies, longer school lunch times are linked to higher student consumption of nutritious foods like more FVs and less plate waste (CDE, 2022). A student's capacity to learn and succeed is also directly correlated with their eating habits (CDE, 2022). The length of time allowed for breakfast and lunch meal periods is not currently regulated by federal or state law, but the Centers for Disease Control advise giving students at least 20 minutes once they are seated for lunch (CDE, 2022). There is not much research on the amount of time to eat as it relates to FV consumption. More research is needed to better understand the relationship between FV consumption and time to eat.

**Purpose of Study**

The purpose of this study is to explore if there is an association between the amount of time students spend eating during lunch time as it relates to their FV consumption, selection, and waste. This is a secondary analysis of baseline from The School Lunch Study, a cluster randomized controlled trial research examining the impact of salad bars and nutrition on fruit and vegetable waste and consumption among elementary, middle, and high school students in Arizona schools. Research has indicated little information about the relationship between the amount of time students have to eat and school food choices and consumption (Cohen et al., 2015). It is hypothesized that the amount of time to eat during lunch is related to students’ F&V consumption.

**Research Aims**

* *Research Question 1***:** Is the amount of time to eat related to students’ fruit and vegetables consumption?
* *Research Question 2***:** Is the amount of time to eat related to students’ fruit and vegetables selection?
* *Research Question 3***:** Is the amount of time to eat related to students’ fruit and vegetables waste?

**Strengths & Limitations**

* Some strengths of this study include the use of objective data gathering techniques to ensure the accuracy of the study's data and findings. Second, the study design was non-invasive in order to not disrupt the participants' eating habits while also allowing for objective and reliable results. The sample size used in this study is quite large, which contributes to the study's generalizability while also supporting the precision of the results. Finally, because most research on nutrition in schools focuses on elementary-aged students, this study explored all grade levels subject to regularly having lunch, allowing for better consistency of results.
* There are some limitations to this study. Researchers were unable to regulate which menu items were served by each school, which may have influenced what students ate. Researchers were unable to account for the time of day that schools provided lunch, or the length of time kids had to eat, both of which could have an impact on student consumption. While researchers requested students not to share or throw away food, it is likely that study participants broke these guidelines, which would have an impact on plate waste.

# Definitions

* **Time to eat**- The amount of time a student has to sit and eat lunch not including adequate seat time but, the length of the meal period overall is important because many activities can shorten time to eat, including using the restroom, handwashing, walking to where the meal is served, waiting in line, selecting items for the meal, waiting to pay, walking to the table, socializing with friends, and bussing trays after the meal
* **National School Lunch Program (NSLP) -** a federal meal program available through the United States Department of Agriculture (USDA) to schools and childcare centers offering funding for participating schools which offer free and reduced lunches that meet specific nutritional standards to qualifying students
* **Healthy, Hunger Free Kids Act of 2010 (HHFKA)-** alegislative act implemented in 2012 which directed a six cent increase in reimbursement per meal served through the National School Lunch Program (NSLP) and School Breakfast Program (SBP) and made significant changes to required nutrition standards of meals served through the NSLP and SBP
* **School Lunch-** a time defined by individual schools or districts for students to eat a lunch meal
* **Fruit and vegetable plate waste-** measured in grams of fruit and vegetable weight after consumption
* **Fruit and vegetable consumption-** gram value of FV weight determined bysubtracting FV plate waste from weight of FV before consumption by student
* **Fruit and vegetable-** (FV) for purposes of this study, fruits and vegetables are defined only as those which are served cold and include entrée salads, salsa, hummus, and canned fruits and vegetables; excludes juice and hot fruits and vegetables or entrees with significant fruit and vegetable components except for entrée salads
* **Fiscal Year (FY)**- also known as a budget year, is a period of time used by the government and businesses for accounting purposes to formulate annual financial statements

CHAPTER 2

REVIEW OF LITERATURE

## Background of National School Lunch Program (NSLP)

The largest of the USDA's child nutrition programs, the National School Lunch Program (NSLP), subsidizes school lunches for millions of American children. Eligible children living in low-income homes can get free or reduced-price meals (Ralston et al., 2017). NSLP is responsible for serving nearly 100,000 schools/institutions school lunches to 29.6 million students each day (“School Meal”, n.d.). NSLP is a nationally funded lunch program that serves students in public and private schools, as well as residential childcare facilities (“NSLP”, n.d.). School lunches contribute greatly to student’s performance, as well as overall health status. At school, many school-aged children consume 30%−50% percent of their daily calories (Schanzenbach, 2009). In fiscal year (FY) 2019, NSLP served low-cost or free meals to 29.6 million children on average every school day, at a cost of $14.2 billion (“NSLP”, n.d.). In fiscal year (FY) 2020, NSLP participation averaged 22.6 million children per school day, with total program expenditures totaling $10.4 billion (“NSLP”, n.d.). These decreases are due to program interruptions in the second part of FY 2020 caused by the Coronavirus (COVID-19) epidemic, which prompted the closure of numerous schools and childcare institutions (“NSLP”, n.d.). The majority of school-aged children's nutritional daily needs are met through school meal programs such as the School Breakfast Program and the NSLP. NSLP’s objective is to deliver one-third of the nutritious content of a child's daily diet at lunchtime (Behrens et al., 2018).

The Health Hunger-Free Kids Act (HHFKA) was implemented by Congress in 2010. HHFKA was made to modify the NSLP's nutrition requirements to coincide with the 2010 Dietary Guidelines for Americans, the first adjustment to school meal nutrition standards since 1994 (Kinderknecht et al., 2020). HHFKA was linked to improved meal dietary quality among low-income, low-middle-income, and middle-high-income kids who were NSLP participants (Kinderknecht et al., 2020). Research was found that school policies appear to be a promising place to explore to apply public health strategies targeted at decreasing obesity since children spend a significant amount of their waking hours at school and consume one-third to one-half of their daily calories there (Schanzenbach, n.d.). According to new data, children are eating the healthiest meals at school, which might be linked to improved exposure to FVs (“School Meal”, n.d.). Children from families with incomes at or below 130% of the poverty level are eligible for free or reduced priced school meals (“School Meal”, n.d.). The Healthy Hunger Kids act focused on improving children's diet by aligning food served at school meals with the most recent dietary guidelines for Americans (DGAs).

Obesity in children is a global public health concern that affects countries of all economic levels (Garden et al., 2020). By the age of 10–11 years, around 34% of children are overweight or obese. Obesity and overweight in children are linked to a variety of medical, psychological, and social problems (Garden et al., 2020). The percentage of children and adolescents affected by obesity has more than tripled since the 1970s (“Obesity”, n.d.). Obesity in children and adolescents is a major problem in the United States, placing them at risk for poor health (“Obesity”, n.d.). The prevalence rate of obesity was 19.3% which affects about 14.4 million children and adolescents (“Overweight & Obesity”, n.d.). Obesity in children and adolescents has become one of the most pressing public health issues of the twenty-first century (Güngör, 2014). Obesity-related comorbid disease entities have emerged as a result of the rising prevalence of pediatric obesity (Güngör, 2014). Obesity in children has a negative impact on practically every organ system and can have significant repercussions (Güngör, 2014). It is also a significant contribution to rising healthcare costs. For all of these reasons, it is critical to avoid childhood obesity and to detect overweight and obese children at an early age so that treatment may begin, and a healthy weight can be achieved and maintained (Güngör, 2014). A key risk factor for the emergence of diet-related chronic diseases such cardiovascular disease, stroke, type 2 diabetes, and particular cancers is being overweight (Nour, et al. 2018). A significant modifiable element in the prevention of diseases is nutrition, and in particular, the consumption of FVs (Nour, et al. 2018).

Prior to the COVID pandemic, 70 percent of the 30 million meals provided daily were to children on the free and reduced-price meal program, many of whom were students of color (Tanner, 2021). As a result of the school closures caused by COVID-19, the 21.9 million students who received free or reduced-price meals under the National School Lunch Program (NSLP) will be unable to consume those calories (Ambrozek & Beatty, 2020). By decreasing or removing items rich in added sugars, saturated fat, and salt from meals and increasing the quantity of fresh vegetables given, school meals may enhance student nutrition (Tanner, 2021).

## Kid’s nutrient intake

**School age kids nutritional needs.** Eating becomes a social phenomenon during this stage of adolescents’ lives. They typically are spending most of their time in school which leaves the school lunch programs to maintain a huge factor of healthy eating of many children. The question of whether school aged kids are receiving adequate nutrition has begun to rise as related to NSLP. Adams et al. (2021) conducted a study on children's nutrient choices and intake during a school lunch, with most of the kids being African American and Latin American. The aim of this study was to quantify the nutrients in school lunch selection and consumption among students participating in the NSLP and compare these values to nutrient recommendations (Adams et al., 2021). The NSLP policy rules require meals to follow suggested nutrient patterns, emphasizing the value of upholding these standards. To maximize the impact of these policies, strategies must be developed to increase children's consumption of nutrient-rich portions of these meals. Most of the children's nutritional needs were generally covered by the meals chosen, but overall consumption patterns show inadequate nutrient intake (Adams et al., 2021). It is though that the National School Lunch Program is for those with racial/ethnic minoritized backgrounds which this study explains how meal programs supported by the federal government, such as NSLP are critical to improve the food quality of systematically disadvantaged people (Adams et al., 2021).

Research by Hirschman & Chriqui (2012) support that legislation and policy have been significantly influenced by monitoring and evaluation studies on school food, which has led to changes in the foods and beverages provided to students at school as part of structured meals and in the individual products sold outside of meal programs. This emphasizes how monitoring school lunch programs could show and give ways for improvement. More research is needed on how aspects of the school environment, like time to eat, relate to students’ FV consumption, selection, and waste.

## School/home food environment of kids

**Food Environment.** At home food environment plays a huge role in the association of school lunch. A study discussed the associations between the family-home nutrition (FN) environment, food insecurity, and dietary intake (fruits, vegetables, whole grains, dairy, protein foods, and added sugars) in rural elementary school-age children (Jackson, 2015). A cross-sectional study in rural primary school-age children investigated if characteristics related to family-home nutrition (FN) are linked to food consumption (Jackson, 2015). The access and food environment play a large role in kids’ dietary intake. Children's home food environments (HFE) have an influence on dietary intake, although few research studies have focused on young children from diverse socioeconomic and racial-ethnic backgrounds (Boles et al., 2019). Food availability (physically in the house), accessibility (within reach of the child's hand), and purchase habits (frequency of acquisition, socioeconomic status, and flavor preference) all impact the HFE (Boles et al., 2019).

Cooking at home may have impact on FV consumption and health benefits, whereas eating out has been highlighted as a risk factor for increased caloric and fat consumption, as well as lower micronutrient intake (Mills et al., 2020). A study investigated the relationships between dietary quality and availability to various types of food outlets near both home and school in primary school-aged children (Barret et al., 2017).

## Effects of school meals on children’s intake

**Obesity.** At school, children consume about half of their overall calorie intake (Baidal et al., 2014). Providing enough time to consume healthy foods like FVs in schools, could potentially reduce the prevalence of childhood obesity. However, we first need to better understand the relationship between dietary intake and time to eat at school. According to the study we discuss in this overview, swapping out high energy density (high calories per weight of food) items with low energy density foods like FVs might be a crucial component of a weight management plan (CDC, Fruit & Vegetables). The research in this summary looked at a wide range of topics, including the links between calories, dietary volume, food type (including fruits and vegetables), satiety, and weight loss (CDC, Fruit & Vegetables). Many of the studies mentioned eating fruits and vegetables, but they did so in the context of something bigger, such preventing or treating high blood pressure or heart disease (CDC, Fruit & Vegetables).

**Food insecurity.** Food insecurity among children has been linked to poor health, social, and academic results. USDA school meal programs and other child nutrition initiatives are meant to promote food and nutrition security (Ralston et al., 2017). In 2021, 10.2 percent of families with children were classed as food insecure (either adults, children, or both) (USDA, 2021). In 87.5 percent of all homes with children, children were found to be food insecure (USDA, 2021). 12.5% of families with children experienced food insecurity in 2021. Only adults were food insecure in some of these homes, whereas children were also food insecure in other households (USDA, 2021). Child nutrition programs in schools have been shown to increase diet quality and academic performance for children from low-income and food-insecure homes (Ralston et al., 2017). Food insecurity is an economic and social condition that, if severe or persistent, can lead to hunger (a physiological condition). Food-insecure families struggle to provide appropriate food for all their members at some point throughout the year owing to a lack of resources (Ralston et al., 2017). Participation in the Supplemental Nutrition Assistance Program (SNAP) or the National School Lunch Program (NSLP) may be one cause of such variations, since enhancing access to healthy meals may reduce the extent to which food insecurity negatively impacts weight status in low-income children (Zhang et al., 2021). Despite the large government spending on food assistance programs, the percentage of households reporting food insecurity has remained high, with 10.5 percent (13.7 million) of US households reporting food insecurity at some point in 2019, including 6.4 percent (8.3 million) with low food security and 4.1 percent (5.3 million) with very low food security (Zhang et al., 2021). The 2019 coronavirus disease (COVID-19) pandemic has significantly changed how people shop for food, and the ensuing economic downturn has increased food insecurity (Litton and Beavers, 2021). Food-insecure people may disproportionately suffer the ill health effects of poor diet during the pandemic since food insecurity is linked to poor diet and notably low intake of FVs. (Litton and Beavers, 2021). According to several research, people with low incomes or those who are food insecure have lower Healthy Eating Index scores, and these individuals also consume less fruit and vegetables (Litton and Beavers, 2021). Consuming FV is linked to lower mortality rates and a lower chance of developing chronic conditions including type 2 diabetes and cardiovascular disease (Litton and Beavers, 2021). Hence, a poor intake of FV may have a role in the rise in the incidence of chronic diseases like diabetes and hypertension that are linked to a lack of access to healthy foods. During the COVID-19 pandemic, the relationship between poor nutrition quality, food insecurity, and chronic diseases is particularly concerning (Litton and Beavers, 2021).

**Taste Preferences**

Children’s preferences, traditions of preparation, cultural preferences, and any restrictions and/or exclusions are important factors in child nutrition. For example, Scaglioni et al. (2008) found that food preferences originate from genetically set predispositions to favor sweet and salty flavors and hate bitter and sour tastes. However, genetic predispositions are changed by experience from birth (Scaglioni et al. 2008).

Taste preferences are impacted by cultural factors. For example, Méndez et al. (2019) explored the cultural perceptions and practices of mindful eating and food parenting among Mexican-American and non-Hispanic white parents of elementary school children. This study reported that cooking traditional Mexican dishes, using one's senses to savor food, and including children in gardening and meal preparation was highlighted as essential elements of Mexican-American participants' mindful eating and food parenting practices (Méndez et al, 2019). Mexican American parents saw food portion restriction differently from non-Hispanic white parents (Méndez et al, 2019). All these factors seem to tie in with taste preferences being that each aspect plays a role in the determination of the predilection of taste. This study was enlightening showing that race and ethnicity have a factor when looking at taste preferences and traditions of preparation. Some of the results in Méndez et al. (2019) study addressed traditional food habits are seen as part of Mexican-American cultural identity, and traditional cuisine is seen as more nutritious than fast food by participants. For populations of color, a major contributing factor to poor dietary intake and chronic disease may be limited access to culturally favored foods (Hearst et al., 2021). Previous studies show that a healthy diet rich in fruits and vegetables helps prevent and manage chronic diseases (Hearst et al., 2021). These results were very important because it allowed its audience to see the view of a proclivity for taste focusing culture (Hearst et al., 2021). Earlier studies show that a balanced diet rich in fruits and vegetables helps prevent and manage chronic diseases, but many people don't consume enough of them, especially Black Americans and communities of color who are recent immigrants (Hearst et al., 2021).  The low intake of healthful foods among these groups is a result of a variety of structural hurdles, some of which are unique to immigrant communities and others of which have more general origins in the long-standing economic injustice and social oppression of colored groups in the U.S (Hearst et al., 2021).

## Food quality

Food quality refers to the total of all a food item's features and attributes that the consumer finds acceptable. The overall nutritional quality of school lunches, as measured by total Healthy Eating Index (HEI)-2020 scores. The HEI is a diet quality metric that assesses how well a group of foods complies with major DGA principles (Healthy Eating Index, 2020). The DGAs are designed for nutrition and health professionals to help individuals (ages 2 years and older) and families to consume a healthful and nutritionally adequate diet (Healthy Eating Index, 2020). The HEI was created in 1995 as a measure to assess the extent to which Americans adhere to dietary guidelines (Healthy Eating Index, 2020). The HEI structure was changed in 2005 and has been altered twice since then (Healthy Eating Index, 2020). In terms of conformity with the core recommendations of the 2015-2020 Dietary Guidelines for Americans, the HEI-2015-2020 is the most recent version of the HEI (Healthy Eating Index, 2020). The HEI evaluates a collection of foods using a score system (Healthy Eating Index, 2020). The scale goes from 0 to 100 (Healthy Eating Index, 2020). A perfect overall HEI score of 100 indicates that the food group fits with essential dietary guidelines from the Dietary Guidelines for Americans (Healthy Eating Index, 2020). The total HEI-2015 score is composed of 13 components that correspond to the various food categories and important recommendations in the 2015-2020 Dietary Guidelines for Americans (Healthy Eating Index, 2020). The total HEI score represents overall diet quality, but the component values, when studied together, reveal a pattern of diet quality (Healthy Eating Index, 2020). The higher the HEI score, the closer a collection of foods (i.e., what you eat and drink as a group) matches with the Dietary Guidelines for Americans (Healthy Eating Index, 2020). Americans have a total HEI-2015 score of 59 out of 100 (Healthy Eating Index, 2020). This snapshot of total diet quality shows that the average American diet does not adhere to dietary recommendations (Healthy Eating Index, 2020). A higher overall HEI score suggests a diet that is more in line with dietary guidelines (Healthy Eating Index, 2020). Since all characteristics are seen as equally vital, the HEI components are weighted equally (Healthy Eating Index, 2020). Some elements of the diet are represented by two components, each with a maximum of 5 points. All other components earn a maximum of 10 points (Healthy Eating Index, 2020). The Healthy-Eating Index - 2015 Data Tables are broken down by gender, age, Race/Ethnicity, Income (% poverty level), and Pregnancy and Lactation Status. A resource provided by the USDA explains the HEI score by age group in Figure 1 & 2 below.

Timeline

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Figure 1. Healthy Index Score

Source: Healthy Eating Index (HEI) | Food and Nutrition Service (usda.gov)

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Figure 2. Healthy eating index for Childhood and Adolescence

Source: [Dietary Guidelines for Americans, 2020-2025](https://www.dietaryguidelines.gov/sites/default/files/2021-03/Dietary_Guidelines_for_Americans-2020-2025.pdf)

Figure 1 summarizes Average Healthy Eating Index-2015 scores for Americans by Age Groups. Figure 2 shows the HEI Scores decline throughout childhood and adolescence, with scores for adolescents approximately 10 points lower than those for young children. The difference between recommended and actual intakes of total fruit and total vegetables emerges and expands as children age. Average by late adolescent years the amount of FVs consumed is roughly half of the amount that is recommended. The quality of the American diet improved somewhat from 2005 to 2012 but declined slightly from 2013 to 2014 (Healthy Eating Index, 2020). Each step toward a diet that adheres to DGAs will help minimize the risk of acquiring diet-related chronic illnesses such as heart disease, type 2 diabetes, and cancer (Healthy Eating Index, 2020)

**Fruit & Vegetables Consumption**

The 2015-2020 Dietary Guidelines for Americans indicate that kids between the ages of 4 and 8 eat up to 2 cups of vegetables and 2 cups of fruit daily, yet many kids only consume an average of 0.8 cups of vegetables and 1.2 cups of fruit daily (Graziose and Han Ang, 2018).

The 2020-2025 DGA recommends eating a diet that is rich in vegetables, fruits, protein foods (including beans and nuts), whole grains, low- or non-fat dairy foods, and unsaturated vegetable oils, and that limits saturated fat, sodium, and added sugars (DGA, 2020). Childhood is a crucial time to establish good eating habits since they have a lasting effect on lifestyle and health. There is evidence that eating behaviors cause non-communicable illnesses such as heart disease, cancer, chronic respiratory disease, and diabetes. (Salwa et al, 2021) Increasing the consumption of fruits and vegetables from an early age is important for improving health outcomes (Taylor et al., 2019). Schools have a significant role to play in addressing the inadequate adherence to FV recommendations among children in the United States (Taylor et al., 2019). Given that a significant portion of children's energy intake occurs at school, updating nutrition standards for school meals, such as the National School Lunch Program (NSLP), has shown positive effects on dietary behaviors among NSLP participants (Taylor et al., 2019). These improvements highlight the potential impact of school-based interventions on promoting healthier eating habits among children (Taylor et al., 2019). Additionally, studies have demonstrated that eating patterns formed in youth persist throughout adulthood (Salwa et al, 2021). Adolescents between the ages of 14 and 18 have the largest disparity between actual intakes and recommended amounts of food groups than any other age group (DGA, 2020). As a result, adolescents are at greater risk of dietary inadequacy than are other age groups. Schools are a great place for interventions, because NSLP has been shown to boost consumption of fruits and vegetables because few kids eat the necessary quantity (Graziose and Han Ang, 2018). A study was done to identify, characterize, and categorize research that objectively examined FV consumption during the school lunch meal among elementary school students in the United States (Graziose and Han Ang, 2018). A lack of FV raises the risk of obesity, which now affects 20% of young children, and chronic diseases that may be avoided (Graziose and Han Ang, 2018). In light of this, the 2015-2020 Dietary Guidelines for Americans advocate putting policies in place to boost the consumption of fruits and vegetables (Graziose and Han Ang, 2018).

The quality of the American diet improved somewhat from 2005 to 2012 but declined slightly from 2013 to 2014 (Healthy Eating Index, 2020). Each step toward a diet that adheres to DGAs will help minimize the risk of acquiring diet-related chronic illnesses such as heart disease, type 2 diabetes, and cancer (Healthy Eating Index, 2020). Research has shown that overall nutritional content of school meals, as judged by total HEI values, did not differ substantially between school types, however specific HEI component scores varied (Bardin et al., 2020). Time to eat may impact children’s HEI scores.

Table

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Figure 3. Average of Healthy Index Scores

Source: [HEI Scores for Americans | Food and Nutrition Service (usda.gov)](https://www.fns.usda.gov/hei-scores-americans)

Experts believe that providing children with access to healthful meals while they are at school can help them develop good eating habits and minimize childhood obesity (Taylor et al., 2012). Unfortunately, because high-fat and high-sugar meals are readily available at school, children confront a range of problems while attempting to 'eat properly' during their time there (Taylor et al., 2012). An investigation into patterns and trends in sociodemographic subgroups of US children and adults' diet quality by food sources was conducted (Liu et al., 2021). Results revealed Food consumed in schools had the highest quality by 2017–2018, followed by food from grocery stores, other sources, workplaces, and restaurants (Liu et al., 2021). Diet quality for foods from schools greatly improved, notably after 2010, and evenly among subgroups (Liu et al., 2021). Overall dietary disparities by sociodemographic status still exist or have gotten worse, but it's unclear whether there are any variances depending on the type of food consumed (Liu et al., 2021). While numerous regulations have been implemented to enhance nutrition, such as the National School Lunch Program, School Breakfast Program, and Child and Adult Care Food Program, children normally obtain a large amount of calories at school and in early care (Liu et al., 2021). However, the nutritional quality of foods consumed in restaurants has largely not improved, and grocery stores remain the main source of calories in the US (Liu et al., 2021).

## Food Waste

For more than 40 years, food waste studies have been utilized in NSLP to examine nutrient intake, nutritional quality, menu performance, food acceptability, cost, and effectiveness of nutrition education (Byker et al., 2017). In FY 2021, the first full year of the pandemic, the program provided 2.2 billion meals, 98.9 percent of which were served free or at a reduced price (Toossi, NSLP) Most of the school food research literature uses the terms plate and food waste interchangeably, thus food waste will be used here (Byker et al., 2017). The uneaten edible fraction of food supplied to an individual is measured in food waste research (Byker et al., 2017) Studies on food waste quantify the edible portion of food given to a person that is not consumed. Food waste methodology can measure the quantity of a particular nutrient as well as other significant food and nutritional outcomes. The types of food groups most likely to be consumed or wasted, compliance with nutrition practices and policies, the impact of nutrition education on food choice and consumption, the acceptability of menu items, and the impact of waste on an institution's budget and on natural resources are all things that should be considered (Byker et al., 2017). The information gathered can be utilized to make significant improvements to a school lunch program's methods, programs, and rules (Byker et al., 2017).

**Cafeteria environment**

Time to eat can be defined as the usual time for serving or eating a meal. There are no national regulations for the length of school lunch periods, and little is known about the relationship between the amount of time students spend eating, school food choices, and consumption (Cohen et al., 2016). A research study was conducted to investigate plate-waste measures from students in the control arm of the Modifying Eating and Lifestyles at School study (2011–2012 school year) to determine the relationship between eating time and school lunch choices and consumption. (Cohen et al., 2016). Having a restricted amount of time to eat may impact students at the end of the lunch line or those arriving late to the cafeteria as research has shown that these students were rushing through the lunch line to optimize their amount of time to eat (Cohen et al., 2016). It's also conceivable that these children realized they'd have less time to eat and hence only chose things they were likely to eat (Cohen et al., 2016). If students are limited on time during lunch, it may be easier for them to choose food options, they are familiar with or quick and unhealthy options rather than healthy alternatives that may be unknown to students, causing them to take longer to consume (CDC, 2019). The Healthy, Hunger-Free Kids Act of 2010 mandated adjustments to the National School Lunch Program and School Breakfast Program dietary criteria. It was discussed in the South Dakota State Extension that the Smarter Lunchrooms Movement was established to encourage healthier food choices among students during school lunchtime. It offers evidence-based strategies that schools can adopt to enhance their lunchrooms, increase the consumption of nutritious foods, and reduce food waste (Extension, S. (n.d.). 2021). Some examples of effective smarter lunchroom strategies include providing pre-cut fruits and vegetables, enhancing meal quality, and scheduling recess before lunch (Extension, S. (n.d.). 2021). By making fruits and vegetables more accessible and appealing, students are more likely to consume them, leading to reduced food waste and improved dietary habits (Extension, S. (n.d.). 2021). Consequently, schools are offering more fruits, vegetables, and healthy grains, while also lowering salt consumption (CDC, 2019). According to studies, allowing extra time for lunch is connected with increased consumption of food and critical nutrients, as well as increased fruit selection, increased intake of fruits and vegetables, and plate waste has been reduced (CDC, 2019). As well as the amount of time to eat, the actual seat time plays a role in the food selection, consumption, and plate waste. Seat time is separate from total lunch time and does not include waiting in line for the food. This distinction between adequate seat time and the overall length of the meal period is important because many activities, such as using the restroom, handwashing, walking to where the meal is served, waiting in line, selecting items for the meal, waiting to pay, walking to the table, socializing with friends, and bussing trays after the meal, can shorten the time to eat (CDC, 2019)

**Cafeteria noise exposure**

Currently, few children in the United States fulfill the daily FV eating requirement. School feeding programs have proven promising in raising FV intake among children. Several characteristics of the school cafeteria setting, however, have not been investigated in terms of their association with FV consumption (Graziose et al., 2019). For example, increased noise levels in cafeterias may reduce FV intake among young children eating school lunches. Greater noise can reduce FV intake in two ways: increased socializing and/or lower hedonic pleasure (Graziose et al., 2019). The link between certain school cafeteria environment variables and the intake of FV by students was investigated in a cross-sectional study (Graziose et al., 2019), which identified three variables strongly associated to kids' FV consumption: the amount of FV products available, cafeteria noise level, and recess order (Graziose et al., 2019). However, no correlations were discovered between students' FV consumption, and the amount of time allotted for lunch or the existence of a self-serve salad bar in this research (Graziose et al., 2019). Importantly, these connections for noise and recess were only significant for fruit and FV intake together, but not for vegetable consumption alone, suggesting that the link was primarily driven by impacts on fruit consumption (Graziose et al., 2019). This study looked at elementary students including 20 different schools only covering a period of 40 days. In order for children to succeed, the cafeteria is a vital classroom where they may learn to create healthy eating habits, nurture social ties, and nourish their bodies (Creating cafeteria, 2017). According to research, the cafeteria setting influences what students consume, which in turn influences their physical well-being, academic achievement, and classroom behavior (Creating cafeteria, 2017).

**Plate waste**

Factors that influence waste in school lunch programs include scheduling of the recess period after lunch, the length of the lunch period, and food preference. Plate waste is generally defined as the quantity of edible portions of food served that is uneaten and is a common reason for food loss at the consumer and foodservice levels (Buzby et al., 2002). In this study, "plate waste" is the amount of edible meal portions that kids throw away annually through USDA school nutrition programs like the National School Lunch Program (Buzby et al., 2002). Since children consume a large portion of their daily caloric intake at school, it is crucial to encourage a balanced diet in this environment. Even while students may get meals at school that adhere to the dietary guidelines, plate waste from school lunches might negatively impact dietary intake and result in an insufficient intake of important nutrients. School lunch plate waste has an impact on children’s dietary intake and meal quality (Zhao et al., 2019). Wide variations in student appetites and energy requirements, discrepancies between meals served and student preferences, scheduling issues that interfere with meal consumption or cause meals to be served when children are less hungry, and the availability of substitute foods from competing sources are possible causes of plate waste (Zhao et al., 2019). Some students may not have enough time to consume a larger quantity of food because of increased amount of fruits and vegetables, Although the impacts on plate waste are not extensively proven in the literature, improving the quality, appearance, and/or acceptability of foods may also be helpful. There is some evidence that other approaches, like adapting serving sizes to students' appetites via self-service and nutrition instruction catered to cafeteria options, can also help reduce plate waste (Buzby et al., 2002). Various fruit and vegetable waste percentages have been found in earlier school studies from before 2012, according to those studies. In one study, 1,030 children from four schools in an urban, low-income school district waste 60%-75% of the vegetables and 40% the fruits on trays (Cohen et al., 2012). These findings were nearly identical to earlier findings from other low-income schools in the state of Massachusetts with a varied ethnic makeup, where fruit waste ranged from 37.2-54.8% and vegetable waste ranged from 30–90% (cohen et al., 2012). Child, community, and foodservice issues all connect to plate waste. The palatability of food, taste preferences, the length of lunch, school policy, and coordination are all factors that affect plate waste. The amount of food wasted on school lunch plates might be reduced by enhancing meal quality and increasing food choice (Zhao et al., 2019). Students who had less time to eat lunch (less than 20 minutes) consumed 12% less of their entrees, milk, and vegetables than those who had more time (at least 25 minutes) (Zhao et al., 2019). Additionally, extending the lunch break for students to give them adequate time to finish their meals decreased plate waste from 43.5% to 27.2% (Zhao et al., 2019). Machado et al., 2020 conducted a one-year study focused on assessing fruit and vegetable waste using digital photographs in an elementary school. The study included kindergarten through fifth grade students, with baseline data collected from 566 trays and follow-up data from 231 trays (Machado et al., 2020). Statistical tests were conducted to analyze differences in waste. The findings from this pilot study suggest that role modeling in the school cafeteria setting could be an effective strategy for promoting health (Machado et al., 2020).

**Summary**

Few kids eat the recommended amount of FV, so schools are an excellent place to implement interventions, like the National School Lunch Program, to boost consumption (Grazoise, 2018). Inadequate consumption of FV increases the risk for obesity and preventable chronic disease (Institute of Med, 2012). Because eating habits established during adolescence persist into adulthood and because obesity is easier to avoid than to reverse, experts have advocated for interventions to promote increased FV consumption in early childhood (Grazoise, 2018). As kids get older, they consume less fruits and vegetables, so it's crucial to intervene early to help kids adopt healthier eating habits (DGA, 2020). Given their extensive reach and capacity to institutionalize effective programs and policies, schools are a valuable location for interventions to increase FV consumption (Grazoise, 2018).

Eating behaviors are complex, resulting from factors across multiple levels of influence including the association between time to eat and students’ FV consumption, selection, and waste. Research has found that giving students 20-30 minutes of seated time (after they have received their meal) is adequate for eating lunch (Creating cafeteria, 2017). The quantity of nutritious foods consumed, and food waste are both impacted by a sufficient lunchtime. For a calmer, quieter dining atmosphere, it's also a good idea to reduce the number of students in the cafeteria by expanding the number of lunch periods (Creating cafeteria, 2017). This advice is supported by more and more data, but less is known about how eating time affects nutrient intake (Creating cafeteria, 2017). The cafeteria is an important learning environment where kids can learn how to establish wholesome eating habits, develop social connections, while taking care of their bodies to thrive.

CHAPTER 3

METHODS

**Study Design**

This was a secondary analysis of a cross-sectional study of baseline data from the School Lunch Study, a large cluster randomized trial that examined the impact of salad bars and fruit and vegetable promotion on increasing FV intake in Arizona elementary, middle, and high schools. Schools included in the sample did not have a salad bar prior to the intervention, participated in the National School Lunch Program, and did not allow for off-campus lunches. A total of 37 schools in Arizona were enlisted by the research team to take part in the study. Baseline data for the study was collected from 2017-2019. Although schools could not be chosen at random to participate, students were selected at random by the researchers prior to each data collection, allowing for a representative sample from each school. Children who received hot lunches were invited to participate and those who brought lunches from home were excluded. Students in special education programs or in detention were also excluded, as they typically receive lunches under different conditions. Students gave verbal assent to participate in the study, and school administrators acted in loco parentis to provide informed consent.

The students were given a barcoded tray and told to choose and pay for lunch as usual if they assented to participate in the study. Researchers handed students a barcoded tray that was identical to the trays used in the school if they were randomly assigned to participate and supplied their assent. With the Study App, the barcode was connected to the student ID. Students were instructed to have lunch as usual, refrain from sharing food, and not to discard any leftovers. The students with barcoded trays were instructed to go to a weigh station before eating. Researchers at the weigh station weighed the student's food, took a photo of the student's meal, and scanned the barcode to the Study App. The students' cold fruits and vegetables were then photographed separately, and their weights were recorded by researchers. When the students had departed the cafeteria, the researchers arranged the student trays for the post-lunch measures. Napkins, straws, and utensils were discarded. Researchers photographed and weighed the entire lunch tray. The researchers then removed any entrees, beverages, desserts, or side dishes and photographed and weighed the remaining cold fruits and vegetables on the tray. These measurements were saved on the Study App using the tray barcode. Researchers requested school staff to adhere to regular lunch practices and to not change the practices on days when researchers were present.

**Measures**

**Time to Eat.** Research assistants timed each student's meal by scanning the barcode on the trays at the beginning and end of each meal when the picture was taken after the point of sale and when the student provided the tray when they were done eating to the study team as described above. Time to eat was calculated by the difference between the end of meal scan and the scan prior to consumption. These were individualized for each participant.

**Fruit and Vegetable Selection, Consumption, and Waste**. Students' FV selection, consumption, and waste are the primary measures for this study. Trained study assistants photographed the fruits and vegetables cold or at room temperature on each student's tray before and after eating. Trays were placed on a digital scale so that the weight of the tray (to the nearest 2 g) was evident in the images at each measurement point. Before and after, photographs of the student's whole lunch were also taken. The following method was used to calculate FV selection, consumption, and waste: The weight of FVs before lunch was used to calculate selection, while the weight of FV left over after lunch was used to calculate waste. The waste weight was subtracted from the selected weight to compute consumption. FV waste was also indicated as a proportion of FV selection, in addition to FV waste in grams.

**Sociodemographic**

Sociodemographic data for students, including race and ethnicity, eligibility for free or reduced lunch, age, academic year, and sex, was reported by schools. These measurements were used to statistically modify the data to account for any possible confounding variables.

**Statistical Analysis**

Descriptive data are presented in means +/- standard deviations. T-tests were conducted to assess differences in time to eat by students’ FV selection, consumption, waste, and sociodemographic variables. Bivariate analysis (Kruskal-Wallis rank sum test & Chi-square test) were conducted. Zero-inflated negative binomial models were run to assess the differences by time to eat and students FV selection, consumption, and waste, adjusted for sociodemographic and clustering of students by school.

CHAPTER 4

RESULTS

**Demographic Characteristics**. Table 1 examines the full sample comparing sociodemographic factors with important elementary, middle, and highschooler results. Using the chi-square test for categorial variables, we observe that there are differences in racial and ethnic groups. Specifically, elementary and middle schoolers took longer time to eat. Additionally, elementary and middle school students selected fewer servings than high school students.

**Selection.** The time to eat was associated with grams of fruit and vegetable selected for elementary students only (IRR=1.003; p=0.060) (Table 2). For students in elementary schools, the more time to eat in minutes is associated with more grams of FV selected (among those who took any fruits and vegetables): there was a 0.5% greater likelihood of selecting fruit and vegetable for every additional minute of taken to eat (Table 2). We did not see a significant relationship between time to eat and FV selection for middle and high school students for those who selected some FV. In the zero-inflated model, a statistically significant relationship was observed between the for the total sample and high schoolers only. For each minute less time students spent eating, there was a 4% lower odds of selecting FV for the total sample and 8% lower odds for high schoolers, respectively (i.e., longer time spent eating greater chance of selecting fruit and vegetables).

**Consumption.** In the overall model, elementary and high schoolers for those that selected some FV, each minute longer a child spent eating was associated with greater grams of FV consumed in the count model. For middle schoolers time to eat is non-significant for grams of FV consumed. We noticed a relationship between the time taken to eat and the grams of FV consumed. There was a .16% higher likelihood of more grams consumed the longer the elementary kids took to eat. For the results of zero-inflated negative binomial regression examining the association between time students took to eat and FV consumed the lunch duration and time to eat was not very correlated (Table 3). In the zero inflated model in High Schoolers for each minute longer of time to eat, there is 5% in the overall model and 8% in high schoolers lower odds of consuming no FV showing this inverse relation (Table 3). In Overall model, elementary, and middle schoolers the odds of consuming no fruit and vegetable are not significantly associated with time to eat. Not surprisingly in middle schoolers there was 2.6% of higher odds of not eating something the longer they had over the lunch period (Table 3).

**Waste.** For those that chose some FV, time to eat was non-significant for grams of fruit and vegetable wasted for overall model, elementary, middle, and high schoolers in Table 4. In the count model it was determined that among those who took something there was no relationship between the time they took to eat and how much they wasted. There was some significance in the sociodemographic such as gender and other (middle schoolers). As for the zero inflated model for the overall model, elementary, middle, and high schoolers the odds of wasting no FV was not significantly associated with time to eat.

**Waste proportion**. In Table 5 we examined the association between time students took to eat and FV wasted as proportion of fruit and vegetable selected by school-level. In the count model the longer they took to eat the less likely they were to waste. In the count model each 10 more minutes spent eating (i.e., time to eat) was associated with a decrease of 6% wasted relative to mean (for those that chose FV) over 1 week which equates to a decrease in percent waste of 16.5%. As for highschoolers, each 10 more minutes spent eating (i.e., time to eat) was associated with a decrease of 14% waste relative to mean (for those that chose FV) over 1 week which equates to a decrease in percent waste of 35%. In elementary and middle schoolers time to eat is non-significant for grams of percent FV waste (for those that selected fruit and vegetable). In the zero model in high schoolers for each minute longer of time to eat, there is 6% likelihood of wasting zero percent of FV selected (for those that selected fruit and vegetable). For overall model, elementary, and middle schoolers the odds of wasting zero percent FV was not significantly associated with children’s time to eat. As well as males were more likely to have a 2.1% higher odds of waste proportion in high school. Furthermore, among those who took nothing compared to those who took something there was a positive relationship between the time to eat and the proportion of kids who wasted as a proportion in highschoolers.

# Demographic Characteristics

Table 1: Demographic Characteristics and Variables of Interest

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | **Full Sample** |  |  |  | **School Type** |  | | |
| **Group** | **Characteristic** | **N Overall** |  | **N** | **Elementary** | **High School** | **Middle School** | **p-value** |  |
|  | Gender | 2,415 |  | 2,415 |  |  |  | 0.7 |  |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| F | 1,120 (46%) | | 342 (45%) | | 427 (47%) | 351 (46%) | |
| M | 1,295 (54%) | | 411 (55%) | | 476 (53%) | 408 (54%) | |
| Unknown | 7 | | 5 | | 2 | 0 | |
| Grade | 2,422 | 7.1 (3.1) | 2,422 | 3.3 (1.3) | 10.4 (1.1) | 7.0 (0.8) | <0.001 |
| Age, yr | 2,323 | 12.2 (3.2) | 2,323 | 8.5 (1.4) | 15.6 (1.3) | 12.2 (1.0) | <0.001 |
| Unknown |  | 99 |  | 4 | 95 | 0 |  |
| Race/Ethnicity | 2,350 |  | 2,350 |  |  |  | <0.001 |
| Hispanic or Latino | 1,490 (63%) | | 440 (58%) | | 601 (67%) | 449 (64%) | |
| White | 552 (23%) | | 184 (24%) | | 220 (25%) | 148 (21%) | |
| Other | 176 (7.5%) | | 70 (9.3%) | | 45 (5.0%) | 61 (8.7%) | |
| Black or African American | 132 (5.6%) | | 60 (8.0%) | | 31 (3.5%) | 41 (5.9%) | |
| Unknown  Free-Reduced Lunch Free/Reduced | 72  2,417  1,881 (78%) | | 4  2,417  562 (75%) | | 8  732 (81%) | 60  0.008  587 (77%) | |
| Paid | 536 (22%) | | 192 (25%) | | 173 (19%) | 171 (23%) | |
| Unknown |  | 5 |  | 4 | 0 | 1 |  |
| F/V Selected N | 2,422 | 379 (16%) | 2,422 | 6 (0.8%) | 245 (27%) | 128 (17%) | <0.001 |
| Y |  | 2,043 (84%) |  | 752 (99%) | 660 (73%) | 631 (83%) |  |
| F/V Self-Served, g | 2,043 | 136.1 (70.6) | 2,043 | 121.6 (64.3) | 139.1 (71.3) | 150.3 (73.7) | <0.001 |
| F/V Consumed, g | 2,043 | 58.3 (54.9) | 2,043 | 43.7 (49.2) | 65.3 (57.4) | 68.3 (55.0) | <0.001 |
| F/V Waste, g | 2,043 | 77.8 (66.0) | 2,043 | 77.9 (55.8) | 73.8 (68.7) | 82.0 (73.8) | 0.006 |
| F/V Percent Waste (post/pre), % | 2,043 | 55.4 (34.9) | 2,043 | 64.6 (31.7) | 49.5 (36.0) | 50.6 (35.1) | <0.001 |
| Lunch Period | 1,925 | 28.4 (12.3) | 1,925 | 24.0 (9.7) | 32.4 (9.2) | 28.8 (15.6) | <0.001 |
| Unknown |  | 118 |  | 118 | 0 | 0 |  |
| Eating Duration | 2,043 | 10.6 (6.5) | 2,043 | 10.0 (8.7) | 11.8 (4.7) | 10.0 (4.7) | <0.001 |

1. n (%); Mean (SD), 2 Pearson’s Chi-squared test; Kruskal-Wallis rank sum test

Table 2. Zero-inflated negative binomial regression examining the association between time students took to eat and fruit/vegetable **selection** by school-level

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | All | | | Elementary school | | | Middle School | | | | High school | | | |
|  | IRRa | SEb | Pc | IRR | SE | P | IRR | SE | P | IRR | | SE | P |
| Time to Eat  Lunch duration | 1.003  1.000 | 1.001  1.002 | 0.060  0.978 | **1.005\***  0.992 | 1.002  1.007 | 0.005  0.209 | 0.999  **1.005\*** | 1.003  1.002 | 0.654  0.029 | 1.000  0.994 | | 1.004  1.004 | 0.961  0.093 |
| Grade | 1.015 | 1.008 | 0.060 | 0.993 | 1.011 | 0.556 | **1.071\*** | 1.020 | 0.001 | 1.027 | | 1.017 | 0.113 |
| Gender, M | 0.977 | 1.019 | 0.212 | 1.006 | 1.028 | 0.818 | 0.963 | 1.030 | 0.216 | 0.961 | | 1.037 | 0.271 |
| Race/ethnicity  Hispanic | Reference |  |  | Reference |  |  | Reference |  |  | Reference | |  |  |
| White | 1.018 | 1.031 | 0.565 | 1.029 | 1.047 | 0.520 | 0.971 | 1.050 | 0.554 | 1.061 | | 1.064 | 0.340 |
| Black | 0.974 | 1.043 | 0.539 | **0.897\*** | 1.057 | 0.047 | 1.127 | 1.068 | 0.069 | 0.899 | | 1.114 | 0.324 |
| Other | 1.051 | 1.037 | 0.168 | **1.192\*** | 1.051 | 0.000 | 0.947 | 1.059 | 0.345 | 0.964 | | 1.085 | 0.648 |
| Paid Lunch | 0.935  Odds ratio | 1.036  SE | 0.053  P | 0.945  Odds ratio | 1.045  SE | 0.200  P | 0.969  Odds ratio | 1.058  SE | 0.583  P | 0.847  Odds ratio | | 1.100  SE | 0.081  P |
| Time to Eat | **0.959\*** | 1.015 | 0.005 | 1.007 | 1.046 | 0.882 | 0.979 | 1.023 | 0.365 | **0.919\*** | | 1.022 | 0.000 |
| Lunch Dur | 1.012 | 1.012 | 0.303 | **0.786\*** | 1.111 | 0.021 | 1.027 | 1.015 | 0.071 | 1.003 | | 1.019 | 0.882 |
| Grade | 1.009 | 1.077 | 0.904 | 1.225 | 1.483 | 0.606 | 1.212 | 1.184 | 0.257 | 0.852 | | 1.103 | 0.103 |
| Gender, M | 1.252 | 1.164 | 0.140 | 2.591 | 2.563 | 0.312 | 0.981 | 1.289 | 0.940 | 1.459 | | 1.223 | 0.059 |
| Race/ethnicity  Hispanic | Reference |  |  | Reference |  |  | Reference |  |  | Reference | |  |  |
| White | 1.464 | 1.225 | 0.060 | 4.581 | 2.815 | 0.142 | 0.962 | 1.422 | 0.911 | **1.842\*** | | 1.307 | 0.022 |
| Other | 0.774 | 1.372 | 0.419 | 0.000 | Inf | 0.998 | 0.575 | 1.685 | 0.289 | 1.002 | | 1.531 | 0.997 |
| Black | 1.811 | 1.428 | 0.095 | 0.000 | Inf | 0.998 | 1.458 | 1.707 | 0.482 | 2.581 | | 1.674 | 0.066 |
| Paid Lunch | **1.595\*** | 1.259 | 0.043 | 0.274 | 3.394 | 0.290 | **3.238\*** | 1.442 | 0.001 | 1.226 | | 1.402 | 0.546 |

a-IRR: incidence rate ratio, b-SE: Standard error, c-P: P-value, \*Indicates a statistically significant value at *P* <0.05 level.

Table 3. Zero-inflated negative binomial regression examining the association between time students took to eat and fruit/vegetable **consumed** by school-level

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | All | | | Elementary school | | | Middle School | | | | | High school | | | | | |
|  | IRRa | SEb | Pc | IRR | SE | P | IRR | SE | | P | | IRR | | SE | | P | |
| Time to Eat  Lunch duration | **1.013\***  1.002 | 1.004  1.004 | 0.000  0.502 | **1.016\***  0.979 | 1.006  1.012 | 0.006  0.090 | 1.008  **1.008\*** | 1.006  1.004 | | 0.244  0.028 | | 1.015  1.002 | | 1.008  1.005 | | 0.050  0.622 | |
| Grade | **1.046\*** | 1.015 | 0.003 | 0.989 | 1.036 | 0.753 | 1.117 | 1.050 | | 0.024 | | **1.075\*** | | 1.033 | | 0.024 | |
| Gender, M | **1.129\*** | 1.046 | 0.008 | **1.252\*** | 1.094 | 0.012 | 1.122 | 1.078 | | 0.125 | | 1.022 | | 1.073 | | 0.755 | |
| Race/ethnicity  Hispanic | Reference |  |  | Reference |  |  | Reference | |  | |  | | Reference | |  | |  | |
| White | 1.029 | 1.077 | 0.695 | 0.976 | 1.153 | 0.866 | 0.990 | 1.127 | | 0.932 | | 1.157 | | 1.122 | | 0.205 | |
| Black | 1.176 | 1.107 | 0.111 | 0.900 | 1.190 | 0.546 | **1.391\*** | 1.176 | | 0.042 | | 1.288 | | 1.240 | | 0.238 | |
| Other | **1.288\*** | 1.093 | 0.005 | 1.266 | 1.175 | 0.144 | 1.260 | 1.151 | | 0.103 | | 1.218 | | 1.179 | | 0.234 | |
| Paid Lunch | 0.976  Odds ratio | 1.084  SE | 0.762  P | 1.045  Odds ratio | 1.147  SE | 0.748  P | 1.087  Odds ratio | 1.149  SE | | 0.551  P | | **0.745\***  Odds ratio | | 1.151    SE | | 0.037  P | |
| Time to Eat | **0.953\*** | 1.013 | 0.000 | 0.988 | 1.016 | 0.452 | 0.969 | 1.024 | | 0.182 | | **0.916\*** | | 1.019 | | 0.000 | |
| Lunch Duration | 1.016 | 1.010 | 0.086 | 0.918 | 1.051 | 0.084 | **1.026\*** | 1.013 | | 0.036 | | 1.010 | | 1.016 | | 0.523 | |
| Grade | 1.041 | 1.053 | 0.440 | 0.974 | 1.143 | 0.849 | 1.052 | 1.149 | | 0.717 | | 0.903 | | 1.083 | | 0.204 | |
| Gender, M | 1.059 | 1.127 | 0.636 | 1.374 | 1.445 | 0.387 | 0.939 | 1.239 | | 0.768 | | 1.103 | | 1.182 | | 0.557 | |
| Race/ethnicity  Hispanic | Reference |  |  | Reference |  |  | Reference | |  | |  | | Reference | |  | |  | |
| White | 1.398 | 1.186 | 0.050 | 1.213 | 1.594 | 0.679 | 1.046 | 1.346 | | 0.878 | | **1.711\*** | | 1.267 | | 0.024 | |
| Black | 1.570 | 1.306 | 0.092 | 1.172 | 2.063 | 0.827 | 1.250 | 1.567 | | 0.619 | | **2.440\*** | | 1.553 | | 0.043 | |
| Other | 1.023 | 1.270 | 0.924 | 0.963 | 1.809 | 0.950 | 0.737 | 1.536 | | 0.477 | | 1.300 | | 1.420 | | 0.456 | |
| Paid Lunch | 1.380 | 1.219 | 0.105 | 1.179 | 1.553 | 0.707 | **1.914\*** | 1.387 | | 0.047 | | 1.327 | | 1.385 | | 0.385 | |
|  |  |  |  |  |  |  |  |  | |  | |  | |  | |  | |

Table 4. Zero-inflated negative binomial regression examining the association between time students took to eat and fruit/vegetable **wasted** by school-level

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | All | | | Elementary school | | | Middle School | | | High school | | |
|  | IRRa | SEb | Pc | IRR | SE | P | IRR | SE | P | IRR | SE | P |
| Time to Eat  Lunch duration | 0.997  **0.993\*** | 1.003  1.004 | 0.292  0.041 | 1.001  0.999 | 1.003  1.009 | 0.709  0.885 | 0.983  0.995 | 1.009  1.006 | 0.065  0.333 | 0.991  0.994 | 1.007  1.007 | 0.196  0.371 |
| Grade | 1.003 | 1.014 | 0.812 | 1.003 | 1.019 | 0.888 | 1.046 | 1.046 | 0.320 | 0.980 | 1.031 | 0.520 |
| Gender, M | **0.901\*** | 1.036 | 0.003 | 0.929 | 1.048 | 0.118 | 0.861 | 1.075 | 0.038 | 0.925 | 1.067 | 0.227 |
| Race/ethnicity  Hispanic | Reference |  |  | Reference |  |  | Reference |  |  | Reference |  |  |
| White | 0.981 | 1.059 | 0.738 | 1.057 | 1.081 | 0.482 | 0.904 | 1.116 | 0.357 | 1.016 | 1.116 | 0.887 |
| Black | 0.915 | 1.085 | 0.274 | 0.968 | 1.101 | 0.736 | 0.863 | 1.168 | 0.343 | 0.915 | 1.226 | 0.664 |
| Other | 0.933 | 1.074 | 0.330 | 1.083 | 1.090 | 0.352 | **0.757\*** | 1.150 | 0.047 | 0.911 | 1.172 | 0.560 |
| Paid Lunch | 0.930  Odds ratio | 1.070  SE | 0.279  P | 0.898  Odds ratio | 1.078  SE | 0.153  P | 0.881  Odds ratio | 1.141  SE | 0.334  P | 1.358  Odds ratio | 1.237  SE | 0.151  P |
| Time to Eat | 0.991 | 1.011 | 0.420 | 1.012 | 1.025 | 0.641 | 0.978 | 1.023 | 0.350 | 0.984 | 1.019 | 0.388 |
| Lunch Duration | 1.010 | 1.010 | 0.336 | 0.936 | 1.052 | 0.200 | 1.023 | 1.014 | 0.091 | 0.993 | 1.019 | 0.710 |
| Grade | 1.060 | 1.059 | 0.305 | 1.202 | 1.145 | 0.173 | 1.005 | 1.165 | 0.975 | 0.910 | 1.089 | 0.265 |
| Gender, M | **1.467\*** | 1.139 | 0.003 | 1.735 | 1.451 | 0.139 | 1.050 | 1.259 | 0.830 | **1.772\*** | 1.195 | 0.001 |
| Race/ethnicity  Hispanic | Reference |  |  | Reference |  |  | Reference |  |  | Reference |  |  |
| White | 1.158 | 1.207 | 0.435 | 1.706 | 1.761 | 0.345 | 0.768 | 1.408 | 0.439 | 1.436 | 1.288 | 0.153 |
| Black | **1.946\*** | 1.332 | 0.020 | 2.625 | 1.704 | 0.070 | 0.890 | 1.662 | 0.818 | **3.483\*** | 1.685 | 0.017 |
| Other | 1.495 | 1.273 | 0.095 | 0.980 | 1.758 | 0.971 | 1.654 | 1.513 | 0.224 | 1.675 | 1.459 | 0.173 |
| Paid Lunch | **1.647\*** | 1.240 | 0.020 | 0.536 | 1.980 | 0.361 | **3.171\*** | 1.426 | 0.001 | 1.324 | 1.385 | 0.389 |

Table 5. Zero-inflated negative binomial regression examining the association between time students took to eat and fruit/vegetable **wasted as proportion** of FV selected by school-level

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | All | | | | Elementary school | | | Middle School | | | | | High school | | | | | |
|  | IRRa | | SEb | Pc | IRR | SE | P | IRR | SE | | P | | IRR | | SE | | P | |
| Time to Eat  Lunch duration | **0.994\***  **0.994\*** | | 1.002  1.002 | 0.011  0.010 | 0.996  1.004 | 1.002  1.003 | 0.068  0.225 | 0.989  0.992 | 1.008  1.004 | | 0.182  0.065 | | **0.986\***  0.994 | | 1.006  1.006 | | 0.027  0.299 | |
| Grade | 0.979 | | 1.010 | 0.024 | 0.990 | 1.016 | 0.547 | 0.969 | 1.041 | | 0.418 | | 0.978 | | 1.026 | | 0.394 | |
| Gender, M | **0.901\*** | | 1.031 | 0.001 | 0.933 | 1.044 | 0.106 | **0.850\*** | 1.065 | | 0.010 | | 0.903 | | 1.058 | | 0.068 | |
| Race/ethnicity  Hispanic | | Reference |  |  | Reference |  |  | Reference | |  | |  | | Reference | |  | |  | |
| White | 1.025 | | 1.051 | 0.621 | 1.034 | 1.070 | 0.627 | 1.021 | 1.103 | | 0.826 | | 1.083 | | 1.097 | | 0.389 | |
| Black | 0.927 | | 1.074 | 0.283 | 1.003 | 1.088 | 0.967 | **0.760\*** | 1.146 | | 0.043 | | 1.073 | | 1.191 | | 0.688 | |
| Other | 0.887 | | 1.064 | 0.055 | 0.938 | 1.080 | 0.410 | 0.798 | 1.132 | | 0.069 | | 0.933 | | 1.148 | | 0.618 | |
| Paid Lunch | 0.958  Odds ratio | | 1.059  SE | 0.453  P | 0.976  Odds ratio | 1.066  SE | 0.705  P | 0.934  Odds ratio | 1.120  SE | | 0.547  P | | 1.092  Odds ratio | | 1.153  SE | | 0.537  P | |
| Time to Eat | 1.028 | | 1.018 | 0.110 | 1.019 | 1.035 | 0.579 | 0.987 | 1.033 | | 0.677 | | **1.061\*** | | 1.025 | | 0.021 | |
| Lunch Duration | 1.016 | | 1.015 | 0.297 | 0.985 | 1.061 | 0.802 | 1.012 | 1.022 | | 0.583 | | 0.989 | | 1.045 | | 0.809 | |
| Grade | 1.131 | | 1.067 | 0.061 | 1.176 | 1.155 | 0.261 | 0.771 | 1.303 | | 0.326 | | 1.033 | | 1.140 | | 0.805 | |
| Gender, M | **1.716\*** | | 1.210 | 0.005 | 1.742 | 1.498 | 0.169 | 1.168 | 1.445 | | 0.674 | | **2.123\*** | | 1.323 | | 0.007 | |
| Race/ethnicity  Hispanic | | Reference |  |  | Reference |  |  | Reference | |  | |  | | Reference | |  | |  | |
| White | 0.528 | | 1.415 | 0.066 | 1.042 | 2.004 | 0.953 | 0.321 | 2.096 | | 0.125 | | 0.644 | | 1.632 | | 0.369 | |
| Black | 1.958 | | 1.456 | 0.074 | 2.779 | 1.716 | 0.058 | 0.327 | 3.360 | | 0.357 | | 3.522 | | 2.111 | | 0.092 | |
| Other | **2.319\*** | | 1.350 | 0.005 | 1.062 | 1.775 | 0.917 | **4.341\*** | 1.716 | | 0.007 | | **3.161\*** | | 1.669 | | 0.025 | |
| Paid Lunch | 1.916 | | 1.401 | 0.054 | 0.840 | 2.226 | 0.828 | 2.479 | 1.935 | | 0.169 | | 2.134 | | 1.639 | | 0.125 | |

CHAPTER 5

DISCUSSION

The purpose of this study is to explore if there was a significant relationship with time to eat during lunch time and students’ FV consumption, selection, and plate waste. From our knowledge, few studies have investigated if differences exist in the FV consumption and the amount of time to eat during school lunch; very few studies have used objective measures of individual students’ lunch times. We report that time to eat was positively related to: FV selection for elementary students who took some FVs; to FV consumption among the overall sample, elementary, and middle school students who consumed some FVs; to the overall FV waste as a proportion for the overall sample and high school students. We also observed an lower odds (inverse relationship) for the time taken to eat and selecting no FVs among for the overall sample and high schoolers; for consuming no FVs among the overall sample and high schoolers for each additional minute taken to eat; and, higher odds of wasting no FVs as a proportion of selection among high schoolers. While the effect sizes were modest, across a week, additional minutes taken to eat could result in significant improvement in the selection, consumption, and waste of FVs in schools. Our findings also indicate that lunch duration and time to eat were not related. These findings suggest that even if students had more time to eat with a longer lunch duration, we are not certain that would affect their FV selection, consumption, or waste. Interventions can be used to influence students to eat more fruit and vegetables at lunch and socialize later to increase consumption. For future research it should aim to validate our study’s results and clarify areas of time to eat and lunch duration relations. More research is needed on time to eat during school lunch especially the amount of time to eat related to students’ FV selection.

We observed that time to eat was significant related to FV selection for elementary students who took some FVs and inversely related to no selection of FVs for the overall population and high school students, indicating that time students take to eat may be important for getting more FVs on the tray for many students across school levels. Understanding the connection between time to eat and FV selection is very important. Adams et al., (2021) showed that FVs had a higher likelihood of being consumed when on the tray. When students select more, they tend to eat more. Research has indicated that the amount of time individuals spends eating influences their food choices, with longer lunch durations associated with increased consumption of healthier options like fruits and vegetables. Therefore, recognizing this link is essential for designing effective interventions to promote healthier eating habits among children. By encouraging kids to spend more time at lunch, we can potentially increase the amount of food they select and, subsequently, consume. To accomplish this, strategies such as creating a pleasant and engaging dining environment, providing ample time for meals, and introducing educational activities related to nutrition can be implemented. However, to fully comprehend the impact of mealtime duration on FV selection, further investigation is necessary. Future research should focus on exploring how modifying the time children take to eat their meals relates to increased selection of fruits and vegetables, ultimately contributing to a more comprehensive understanding of strategies to enhance children's dietary habits.

Having an adequate amount of time to eat during lunch has a notable impact on students' FV selection. Previous research studies have demonstrated that when students are given sufficient time to eat their eating habits are different. In contrast, students with limited time to eat were more likely to opt for less healthy options or skip fruits and vegetables altogether. Another study by Mâsse et al. (2014) examined the impact of time to eat on fruit and vegetable selection in a high school setting. The researchers observed that students who had sufficient time to eat lunch were more likely to select and consume fruits and vegetables compared to those with shorter lunch periods. The findings in the Mâsse et al. (2014) study indicated that longer time to eat facilitated students' ability to include healthier options in their meals. Furthermore, a study by Hanks et al. (2015) focused on the impact of time to eat on fruit and vegetable consumption among middle school students. These studies collectively highlight the significance of time to eat in influencing students' FV selection. When students have enough time during lunch, these studies found that students are more likely to choose and consume these healthy options. It emphasizes the importance of ensuring that students are given sufficient time to eat, allowing them to make healthier choices and contribute to a well-balanced diet.

There was a relationship between the time taken to eat and the grams of FV consumed. In elementary students there was a .16% higher likelihood of more grams consumed the longer the kids took to eat. We observed a relationship between time taken to eat and the grams of FVs consumed for all students. However, our analysis did not show significance for time to eat and grams for fruit and vegetables consumed in middle schoolers. Cohen et al. (2016) explored the impact of time to eat on fruit and vegetable consumption and selection among adolescents as measured by plate-waste methodology. The findings indicated that when students had less than 20 minutes to eat, students were considerably less likely to choose a fruit compared to when they had at least 25 minutes to eat. The study highlighted the positive association between time to eat and increased consumption of these nutritious foods. A study by Taylor et al. (2019) assessed the impact of lunch duration on food consumption among middle and high school students. The researchers found that students who had shorter lunch periods consumed fewer fruits and vegetables compared to those with longer lunch periods. These studies measured time to eat as duration or lunch period, whereas our study used objective measures for individual students to measure time to eat and fruit and vegetable selection, consumption, and waste. The fact that the time taken to eat is linked to consumption holds significant implications for school nutrition programs and future research. Understanding this relationship is vital because it sheds light on an actionable factor that can be targeted to improve dietary outcomes. When individuals take more time to eat, they tend to consume larger quantities of food, including fruits and vegetables. This information is particularly relevant in the context of school nutrition, where efforts are made to encourage healthier eating habits among students. Schools can leverage this knowledge by implementing strategies to promote a slower eating pace, such as extending lunchtime or providing a relaxed dining environment. Additionally, nutrition programs can incorporate educational components to teach children about the importance of mindful eating and savoring their meals. By capitalizing on the link between time taken to eat and consumption, school nutrition initiatives have the potential to positively impact students' dietary choices and overall health. Furthermore, future research should explore this relationship in more depth, examining how specific interventions targeting lunch duration affect consumption patterns. This research can inform evidence-based practices and contribute to the development of effective strategies to improve nutrition in school settings. .

Among those who took nothing compared to those who took something there was a positive relationship between the time to eat and the proportion of kids who wasted as a proportion among the overall sample and highschoolers, indicating lower waste with more time taken to eat. In 2021, strategies were discussed to address plate waste in schools, focusing on food-waste audits and the implementation of "offer vs serve" policies (Extension, S. (n.d.). 2021). The "offer vs serve" approach allows students to choose or decline specific components of their meals. Another strategy explored was the use of share tables, where students can return uneaten food or beverage items that meet health and safety regulations (Extension, S. (n.d.). 2021). Studies have shown that students should be given a minimum of 20 minutes to sit and eat, as opposed to just having a 20-minute lunch period (Extension, S. (n.d.). 2021). Increasing lunch periods from 20 to 25 minutes resulted in a 13% decrease in waste, but the best practice is to provide a 30-minute lunch period (Extension, S. (n.d.). 2021). When students have more time to eat, they tend to consume a greater portion of their meals and feel less rushed, resulting in reduced plate waste. While our study found that longer lunch duration was linked to lower waste among students who wasted some FVs, when explored by school level, that association was no longer statistically significant. Taking more time to eat was more persistently related to less FV waste for students, suggesting that time to eat may be more impactful than duration, although future research would need to verify this cross sectional finding. Another study by Cohen et al. (2016) explored the relationship between time to eat and food waste, including fruits and vegetables, in elementary schools. The researchers found that schools that provided students with more time to eat observed lower levels of food waste, including fruits and vegetables, compared to schools with shorter lunch periods. It highlights the importance of ensuring that students are encouraged to take adequate time to eat, which can contribute to minimizing food waste and promoting sustainable eating habits.

The amount of time to eat during lunch in school can vary depending on the overall lunch duration set by the school; however, we found little evidence that duration impacted the time students took to eat. Although each school may require a distinct approach, there are numerous suggestions and best practices to consider for determining lunch duration (Making time for lunch, 2019). In previous research the duration of lunchtime in schools plays a significant role in influencing students' food choices, consumption patterns, and waste generation, particularly when it comes to fruits and vegetables (Cohen et al., 2016). Research studies have examined the impact of lunch duration on these factors, highlighting the importance of adequate time for students to make healthier choices, consume their meals, and minimize waste. In a systematic review by Turner et al. (2018), the authors analyzed multiple studies investigating the impact of lunch duration on food selection, consumption, and waste in school settings. Turner et al. (2018) study revealed that increasing lunch duration was consistently associated with improvements in students' food choices, consumption of healthier options like fruits and vegetables, and reductions in food waste. A study by Taylor et al. (2019) examined the relationship between lunch duration and the time available for eating among middle and high school students. The researchers found that longer lunch periods were associated with more time available for students to consume their meals fully, including fruits and vegetables. Another study by Johnson et al. (2011) examined the impact of lunch duration on food consumption among middle school students. The researchers discovered that students who had shorter time to eat consumed fewer fruits and vegetables compared to those with longer time to eat.

Another major finding was that lunch duration and time to eat had minimal correlation which was an unexpected finding. Being that the average time students took to eat was about 10 minutes regardless of how long their lunch period was. Our results showed that lunch duration was not closely related to the time students took to eat, nor was rarely related to fruit and vegetable consumption, selection, and waste. However, it's worth noting that the specific amount of time allocated for eating within the overall lunch period can be affected by various factors including scheduling constraints being that Schools may have limited time available for lunch due to scheduling constraints, such as a need to accommodate multiple lunch shifts to accommodate a large student population. Factors such as the time required to line up, collect meals, find a seat, and clean up afterward can impact the actual time available for eating within the designated lunch period. As well as other activities during lunch being that some schools incorporate other activities within the lunch period, such as recess or socializing time, which can reduce the amount of time specifically dedicated to eating. Various studies focused on the well-being and association of fruits and vegetables whereas our study solely focused on time to eat. It is important for schools to strike a balance between providing enough time for students to eat their meals and ensuring that the overall lunch period fits within the broader schedule of the school day.

Future research on this topic will allow a better understanding of how time to eat during school lunch affects FV consumption, selection, and waste. Future research should focus on lunch duration and time to eat being that our findings discovered there is no relationship between the two. Many barriers have been discovered for time to eat as it relates to fruits and vegetables, which may be influencing student eating habits thereby potentially impacting their health. Research suggests that providing additional social time aside from lunch can have a positive impact on students' fruit and vegetable intake (Machado et al., 2020). Engaging in social interactions during breaks or recess periods encourages students to share and consume healthier food options, including fruits and vegetables. Interventions and/or school regulations that promote higher student fruit and vegetable selections and consumption while limiting waste during lunch could lead to positive health outcomes. A study by Evans et al. (2012) examined the influence of social support and social norms on fruit and vegetable consumption among middle school students. The researchers found that when students had additional social time outside of lunch, such as during recess, they were more likely to engage in positive social interactions related to food choices. These interactions included sharing and discussing fruits and vegetables, which ultimately led to increased consumption of these healthy foods. These studies suggest that additional social time aside from lunch can positively influence students' fruit and vegetable intake. Engaging in social interactions during breaks or recess periods provides opportunities for students to share and discuss healthier food choices, encouraging higher consumption of fruits and vegetables. These future studies would allow a deeper understanding of how lunch duration and additional social time could affect time to eat, and subsequent FV selection, consumption, and waste.

Though this study has several strengths, there are some limitations that should be addressed. This study was not able to regulate which menu items were served by each school, which may have resulted in differential selection, consumption, and waste the study was unable to prescribe the time of day that schools provided lunch, or the length of time kids had to eat. For elementary students, we were unable to control the presence/timing of recess, could affect students eating behaviors if recess was before or after lunch. This study was only can pertain to schools without salad bars and participated in NSLP. The study also only looked at cold FV intake, so it's probable that some FVs were left out, such as hot FV sides or those included in entrées which could present an interpretation of the findings. Although we advised students not to share or throw away any food, we will never know for sure being that no one was able to watch each student during lunch to ensure this. This was a cross-sectional study, so causality cannot be determined. Strengths of the study include that the study design was non-invasive in order to not disrupt the participants' eating habits while also allowing for objective and reliable results. Next, this study used participant blinding meaning students were generally unaware of the purpose of the study. Students were randomly selected to participate in the study. The use of objective data gathering techniques ensures the accuracy of the study's data and findings. This study has a large sample size, which contributes to the study's generalizability while also supporting the precision of the results. Additionally, this study included participants from elementary, middle, and high schools, enhancing its generalizability to students in all grade levels allowing for better consistency of results.

CHAPTER 6

CONCLUSION

This study aimed to explore the relationship between the amount of time students take to eat during lunch and their FV consumption, selection, and plate waste. This study found that depending on school level, time to eat was linked to student FV selection, consumption, and waste. The findings also revealed that lunch duration and time to eat were not closely related, contrary to previous literature. Future research needs to be more explicit about whether findings are a result of duration and time taken to eat, as our research indicates these are distinct concepts. Overall, it was discovered that more time spent eating was related to greater FV consumption. The amount of time students spent eating was not related to FV selection, or FV waste. The study highlighted the need for further research on time to eat, particularly in relation to students' FV selection. It also emphasized the importance of interventions and school policies that promote healthier food choices and increased consumption of FVs during lunch. Additionally, the study acknowledged the impact of scheduling constraints, lunchroom factors, and other activities during lunch on the specific amount of time available for eating within the overall lunch period. Research studies cited in the document consistently demonstrated that longer lunch periods and sufficient time to eat were associated with improved food choices, increased consumption of FVs, and reduced food waste. The findings underscored the significance of providing adequate time for students to eat, enabling them to make healthier choices, consume their meals fully, and minimize waste.

Future research should aim to validate the study's results and further investigate the relationship between lunch duration, time to eat, and students' FV consumption, selection, and waste. It is important to explore the potential impact of additional social time during breaks or recess periods on promoting healthier food choices and higher consumption of FVs. By addressing these areas of inquiry, a better understanding can be achieved regarding how lunch duration and socialization opportunities can influence time to eat and ultimately improve students' dietary habits and overall health.

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