

SCHOOL HEALTH POLICY: SCHOOL LUNCH CONSUMPTION PATTERNS
OF MIDDLE SCHOOL STUDENTS

By

Kathleen Dykes Young

Submitted to the

Faculty of the College of Arts and Sciences

of American University

in Partial Fulfillment of

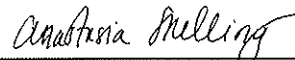
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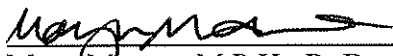
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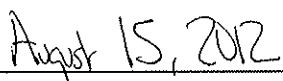
Chair:


Anastasia Snelling, Ph.D., R. D.


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Dean of the College of Arts and Sciences



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ABSTRACT

The Healthy Schools Act (HSA) was passed in May of 2010 with the goal of encouraging Public Schools and Public Charter Schools of the District of Columbia (DC) to address the issue of childhood obesity in DC. One provision of the HSA is to improve school nutrition by specifically increasing servings of fresh fruits and vegetables in school lunches. The purpose of this study is to measure consumption patterns of fruits and vegetables of middle school students in two middle schools in D.C. following the implementation of the new school lunch standards. An intervention was implemented to determine if serving whole versus cut fruit would significantly influence consumption patterns of the students. Of the 4,464 lunch trays observed during a two-week period, it was determined that a significantly higher percentage of servings of fruits (66%) were consumed than servings of raw (54%) and cooked (46%) vegetables. Students also consumed a significantly higher percentage of servings of a whole apple (41%) when served with lunch than a sliced apple (29%). Although the HSA mandates that schools provide healthy lunches, low consumption rates indicate that students may not be benefiting from the new nutrient standards. Health disparities, parental and familial eating behaviors, participation in the National School Lunch Program, and behavior economic strategies related to eating habits need to be explored to fully understand and improve impact eating behaviors in children.

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CHAPTER 1

INTRODUCTION

The prevalence of obesity has increased substantially in the last three decades. From 1976-1980 to 2007-2008, the obesity prevalence increased from 15% to 34% in adults and 5% to 17% among children and adolescents (Freedman, 2011). Overweight and obese children are at a higher risk to become overweight or obese adults than children at normal healthy weights. The obesity epidemic has taken a toll on health care costs as chronic diseases associated with obesity are on the rise. In 2008, medical costs related to obesity were an estimated \$147 billion, accounting for 10% of all medical expenditures (Finkelstein et al., 2009). With the increase in obese children and projected health care costs, the childhood obesity epidemic has gained national attention.

Schools have continuous contact with children during the first two decades of their lives. Meeting state standards, most schools are required to have 175 school days per year for six hours per day. This means that children and adolescents spend at least 20% of the year in school during the impressionable years of their development. Many agree that due to the intense number of contact hours with children, school policies have a strong impact on children's health. More specifically, much of children's caloric intake is consumed during the school day. Katz et al. (2005, 2011) argue the potential for schools as important roles in health programming. Many schools have facilities that can support regular physical activity, as well as staff inside and outside of the classroom to serve as role models for students and aid in the implementation of a health program. Despite limited school budgets, schools can still encourage healthy lifestyles to students by incorporating health and wellness education and physical activity into already existing school programs. This can be achieved through school curricula to develop student

knowledge and attitudes, staff programs, and policy interventions. Changes in the physical environment, such as offering healthier choices in school cafeterias and vending machines can help promote healthy eating habits (Katz et al. 2005, 2011).

Policymakers, researchers, and media can aid in implementing school health programs focused on the promotion of healthy diets and the undertaking of obesity in children (Jaime and Lock, 2009). Specifically, school meal programs such as the National School Lunch Program (NSLP) and School Breakfast Program (SBP) can play a key role in influencing children's diets and ultimately their weight and health status. The National School Lunch Program provides approximately 19 million free or reduced-price lunches to children in the United States each school day (Gundersen et al., 2012). In 2009, National School Lunch Program expenditures of \$10 billion went towards providing meals to students (Gundersen et al., 2012) Because of the NSLP and school breakfast programs, some children consume a significant portion of their calories during the school day (Gleason and Dodd, 2009). The School Nutrition Dietary Assessment Study (SNDA-III) indicated that children participating in the NSLP consumed 35% of their daily calories from foods offered at school, while children participating in both the NSLP and SBP consumed almost half (47%) of their daily calories (Gleason and Dodd, 2009).

In 2010, the District of Columbia passed the Healthy Schools Act (HSA) that addresses childhood obesity by requiring schools to increase health education and physical education contact hours for students, as well as develop school health profiles while establishing school wellness councils. The HSA complements the NSLP in that it also speaks to the nutrient content of school meals. Under the NSLP and the Healthy Schools Act 2010, nutritional standards of school meals have increased in DC public schools so that meals will have less sodium, and fewer calories from fat and added sugar. School meals are required to serve a different fruit and

vegetable each day, and provide fresh fruit at least two days of the week. With such policies in place, it is estimated that healthier lunches will have a positive influence on the health of the students consuming school meals. However, studies report little or no strong evidence of a relationship between participation in a school meal program and overweight and obesity in children (Gundersen et al., 2012; Gleason and Dodd, 2009). There have been few studies investigating students' consumption of school meals now that the new nutrient standards have gone into effect. It is necessary to first understand if students are consuming the healthier school meals and, beyond the scope of this study, investigate if these nutritional standards influence their health.

Purpose

The purpose of this study is to measure consumption patterns of fruits and vegetables of middle school students in two middle schools in the District of Columbia. This study will also investigate potential factors that influence students' preference for particular types of fruits and vegetables in the school lunch.

Research Questions

1. What is the percentage of school lunch fruits and vegetables consumed by middle school students of Alice Deal School and Kelly Miller School?
2. Is there a significant difference in consumption patterns of fruits and vegetables between students of a Ward 3 and Ward 7 school, Alice Deal School and Kelly Miller School, respectively?
3. Is there a significant difference in consumption patterns of whole fruit and cut fruit among middle school students?

Hypotheses

H₀₁: There will be no difference students' consumption of fruits and vegetables.

H₀₂: There will be no difference in the consumption patterns of fruits and vegetables between students of Alice Deal School and Kelly Miller School.

H₀₃₂: There will be no difference in student consumption patterns between whole fruit and sliced fruit.

Definition of Terms

Body Mass Index - a calculated weight to height ratio (kg/m^2) used to measure overweight and obesity in children and adults.

Healthy Schools Act 2010 - encourages DC Public and Charter schools to improve school nutrition, physical and health education, increase student physical activity time, establish school gardens, and collect data to develop school health profiles.

National School Lunch Program - originally established in 1946 under the National Schools Lunch Act, this is a federally assisted (USDA) meal program for public, non-profit private schools and residential child care institutions. Students are provided low-cost or free lunches upholding nutritional standards that meet the Dietary Guidelines for Americans.

Obese - For children between ages 2-19 years, having a BMI greater than or equal to the sex-age-specific 95th BMI percentile.

Overweight - For children between ages 2-19 years, having a BMI greater than or equal to the sex-age-specific 85th BMI percentile.

Plate waste - a quantity of edible portions of food for human consumption that is discarded.

Assumptions

DC Central Kitchen is the main food service vendor who supplies school lunches to Alice Deal School and Kelly Miller School. All hot meals are pre-portioned by kitchen staff and distributed to the students. It is assumed that all students receiving a tray from the hot meals line received equal portions and similar types of the food items at both schools. It is also assumed that students consumed food items from their own tray and the amount of food shared between or among students' trays was minimized.

Limitations

There are some limitations to this project due to the variability during data collection. It will be difficult to accurately measure plate waste of all students at both schools concurrently. We assume that students are consuming their own lunches; however, we must recognize that some students will share their food with their peers. In the case of students sharing food it is possible that they will have consumed more or less of the food items from their tray. Some students may also bring lunches from home which can also lead to variability if they are eating items from home and items from the school lunch. Some students may also receive a second helping or more from the lunch line once all lunches are served. On the other hand, students can opt out of receiving one or more of the available food items of the hot meal. It is important that the lead researcher note this when collecting data. If this is not noted, a student can be mistaken for eating 100% of a food item that was not originally on the tray.

The different cafeteria environments of Alice Deal School and Kelly Miller School can add some variability to this project. Alice Deal School has a salad bar as a school lunch option. Students are supposed to only receive a lunch from the hot meal line or the salad bar. However, some students have mixed lunches which would lead to inaccurate plate waste observations or

could complicate observations of hot meal consumption patterns. In an attempt to reduce this variability, trash cans labeled "salad bar waste only" were available to separate lunch waste from the salad bar and hot meal line.

In addition to the different cafeteria environments between the schools, differences in the school meals are noted. Although recipes and food items were indicated to be the same at each school, there appeared to be slight variations in food preparation and cooking techniques. For examples, on one day when chicken was served, there were differences in spices added and the size of the chicken pieces served to students. Also, one day students at Kelly Miller School were served cantaloupe wedges while Alice Deal School students were served cut pieces of cantaloupe. On the day of testing the intervention of serving a cut apple, only sixth grade students at Alice Deal School received cut apples. Students in grades 7 and 8 could not be served the cut apples due to oxidation from exposure to air.

Because data collection had to occur at the two schools concurrently, a research team was formed to observe student lunches. Because the data collection is somewhat qualitative through personal observations of school lunch trays, some of the data entered into the V-Project application may vary. An attempt to assign small consistent research teams was made to avoid some variability. However, the perceptions of food consumption at one school may be slightly different than at the other school. Lead researchers making all of the observations of plate waste and consumption patterns collaborated to avoid this variability as much as possible. All research team members were trained on how to use the V-Project application, record data, observe lunch trays and ways to avoid variability. Through training sessions and collaboration among team members, the level of variability among observations of researchers was reduced.

It is also important to note the limitations of the V-Project application. Because this smartphone application was created for a specific plate waste study, applying it to our study does have limitations. The application only allows the user to enter observed consumption patterns of 0%, 50% or 100% of each food item and does not include consumption of any other percentages, i.e. 75%. Observations of consumption were rounded to one of the three values available on V-Project.

CHAPTER 2

LITERATURE REVIEW

Overview

This chapter provides an overview of the overweight and obesity prevalence on a national level and a local level here in the District of Columbia. This chapter also focuses on ways in which school health policies can play a role in alleviating childhood obesity and overweight prevalence. Because this study investigates consumption patterns of students after implementation of the Healthy Schools Act, this chapter also reviews eating behaviors in children and plate waste studies.

Overweight and Obesity

The obesity epidemic and its link with chronic diseases have become a topic of high interest in the last few decades. In reaction to the alarming obesity prevalence and risks associated with it, the U.S. Department of Health and Human Services program, Healthy People 2020, focuses on prevention of weight gain in youth populations. In general, the goals of this program are to “increase quality, availability and effectiveness of educational and community-based programs designed to prevent disease and injury, improve health and enhance quality of life (Healthy People 2020).”

The World Health Organization has identified obesity as a disease. Obesity and overweight are conditions of abnormal or excess body fat accumulation that could impair health (WHO, Obesity, 2012). Body mass index, BMI, ($\text{weight (kg)/height (m}^2\text{)}$) is commonly used to measure obesity in adults and children as it has been correlated with body fat and obesity health related consequences (Wang and Beydoun, 2007). Using BMI, the WHO defines overweight as having a BMI higher than or equal to 25, and obese as having a BMI higher or equal to 30

(WHO, Obesity, 2012). Other organizations, such as the National Heart, Lung and Blood Institute, as reported by Wang and Beydoun (2007), recommend also using waist circumference measurements to define central obesity concerns.

Body mass index is used to measure obesity and overweight in children and adolescents. An earlier version of BMI measurement for children ages 6 to 19 years old was utilized in the NHANES study in the 1970's in which BMI was gender and age-specific. "Overweight is defined as having a BMI greater than or equal to the sex-age-specific 95th BMI percentile and at risk for overweight is defined as a BMI greater than or equal to the 85th percentile but less than the 95th percentile" (Wang and Beydoun, 2007). In 2000, the Centers for Disease Control and Prevention (CDC) developed new growth charts for BMI 85th and 95th percentiles for U.S. children ages 2 to 19 years using data from national studies between 1960-1994 (Wang and Beydoun, 2007). The most current CDC growth charts simply enhanced aspects of the scales and graphs but still use the guidelines and data points indicated in the 1977 charts. There is no BMI-for-age reference to define overweight for children younger than two years old. The weight-for-length 95th percentile has been used to assess obesity in children of this young age (Wang and Beydoun, 2007).

Observations of the trends in obesity rates in adults have provided some insight to the obesity epidemic among children as they are related. Children who are overweight or obese are more likely to be overweight or obese as adults. The CDC reports that approximately one in three (33.8%) adults in the United States is obese (CDC, Adult Obesity, 2011). The National Health and Nutrition Examination Survey (NHANES) conducted by the National Center for Health Statistics, collected height and weight data through an extensive study assessing health and nutrition status of adults in children in the United States since the 1970's (CDC, national

Health and Nutrition Examination Survey, 2012). Flegal et al. (2010) summarize the prevalence and trends in obesity among U.S. adults using NHANES data. The prevalence of adult obesity had increased by 8% from 1976-1980 to 1988-1994 (Flegal et al., 2010). There was a significant increase, as obesity prevalence was relatively stable from 1960-1980. Since the 1980's obesity rates have continued to increase. The latest NHANES data of 2007-2008 revealed a prevalence of obesity of 32.2% among adult men and 35.5% among adult women (Flegal et al., 2010). Wang and Beydoun (2007) performed a systematic review and meta-regression analysis of over 80 journal papers, reports and online data sheets related to obesity. After pooling their data, Wang and Beydoun reported an obesity prevalence increase from 13% to 32% in adults between the 1960's and 2004. When considering adults who are overweight and those who are obese, 66% of U.S. adults fall into this group (Wang and Beydoun, 2007).

As there has been much attention given to obesity rates among adults, recently, more studies have focused on obesity rates in children. Obese children are reported to be more likely to become obese adults, and even be more severely obese as adults (Biro and Wien, 2010). Globally, 10% of school-aged children are considered overweight (Sharma 2011). In the past twenty years, the number of obese children in the United States has almost tripled. According to the National Health and Nutrition Examination Survey (NHANES) of 2005-08, 16% of children and adolescents, ages 2-19 years old, were considered obese. Minority children are at even greater risk, with 38% overweight and 20% obese Mexican Americans and 34.9% overweight and 20% obese Non-Hispanic Black (Ogden, 2010). The Centers for Disease Control and Prevention (CDC) reported that 12% of high school students were obese in 2009, with 78% of surveyed students consuming less than five servings of fruits and vegetables per day. Unfortunately, this data was not broken down by race/ethnicity. Nutrition and physical activity

are a concern in youths with children ages 8-11 years old who average slightly over three hours per day sitting watching television or playing video games (CDC, Childhood Overweight and Obesity 2010).

Currently, there have been an increasing number of studies indicating the risks associated with overweight and obesity in children and adolescents. Sharma (2011) referenced the Bogalusa Heart Study (1999) which found that 60% of overweight children have at least one biochemical or clinical cardiovascular risk factor and 25% overweight children have two or more risk factors by the time they turn ten years old. Negative consequences for children overweight include Type 2 diabetes, elevated cholesterol, fatty liver, arthritis, sleep apnea, gall bladder disease, asthma, depression, discrimination, low self-esteem, peer rejection and stigmatization (Sharma, 2011).

It is well accepted that two of the most influential factors resulting in overweight and obesity are excessive energy consumption and inadequate physical activity. Biro and Wien (2010) summarize other contributing factors to the obesity epidemic in children and adolescents such as complex interactions between genetics and the environment. Some reports have indicated a genetic cause of childhood obesity which is inherited through a mutation in the FTO gene and other genes that have been connected with leptin deficiency (Welsh et al., 2010). Children born prematurely, small for their gestational age, or large for gestational age have been correlated with higher prevalence obesity (Biro and Wien, 2010). Infants born from mothers with diabetes also have a higher risk of obesity (Catalano et al., 2009).

More studies have concentrated on defining the environmental factors that contribute to childhood obesity. There is growing concern as children are less active as reports have shown that children ages 8-11 years old spend slightly over three hours to up to more than seven hours

per day sitting in front of the television or playing video games (CDC, Childhood Overweight and Obesity 2010). A significant increase in consumption of snacks in adolescents in conjunction with lower activity levels has been a concern. In a study by Jahns et al. (2001) snacking in children increased significantly between 1977 and 1996. In 1977, children ages 6-11 years consumed snacks that contributed to 18% of their total energy consumed, and this rose to 25% in 1996. Adolescents, ages 12-18 years, consumed 21% of their total energy through snacks, which rose to 25% in 1996 (Jahns et al., 2001). Portion size accounted for 17-19% of the variability in energy intake (Jahns et al., 2001). Bowman et al. (2004) reported that 30% of their study cases ages 4-19 years old consumed fast food daily. An increased intake of sweetened beverages and the frequency of and large portion sizes of energy-dense foods is correlated with obesity rates in children (Biro and Wien, 2010). In addition to the changes in dietary patterns in children, a decrease in physical activity has also been associated with a high prevalence of obesity (Biro and Wien, 2010; CDC, Childhood Overweight and Obesity, 2010). Reports have indicated that over 60% of children's television commercials are food related (Borzekowski and Robinson, 2001). In this case, children are not only being sedentary by watching television, but they are also exposed to high-energy foods.

As much as obesity is a concern for the health of adults and children, it has also become a financial burden in the health care system. Medical expenditures resulted from obesity were estimated by Finkelstein et al. (2009) to be \$78.5 million in 1998, with half of those costs carried by Medicare and Medicaid. Finkelstein et al. (2009) also report updated data indicating that health costs related to obesity accounted for \$40 billion of increased medical spending in 2006. Of that amount, \$7 billion were put towards Medicare prescription drug costs. Results also indicated that across all medical payers, "obese people had per capita medical spending that was

\$1,429 (42%) greater than spending for normal weight people in 2006” (Finkelstein et al., 2009). In 2008, obesity costs rose to \$147 billion, almost 10% of all medical spending (Finkelstein et al., 2009). With an increase in the number of adult cases of obesity and cases in children and adolescents, obesity will continue to have a detrimental effect on health care costs.

Health Disparities

The CDC defines health disparities as "preventable differences in the burden of disease, injury, violence, or opportunities to achieve optimal health that are experienced by socially disadvantaged populations" (CDC Health Disparities, 2012). Disadvantaged populations are often defined by race or ethnicity, gender, sexual orientation, education or income, or geographic location (CDC Health Disparities, 2012). The differences in health outcomes and their determinants between segments of the population are related to social, demographic, political, economic, environmental, and geographic attributes (CDC Health Disparities, 2012; Truman et al. 2011). Some of the largest contributors to health disparities are poverty, environmental threats, inadequate access to health care, education inequalities, stress, and individual and behavioral factors (CDC Health Disparities, 2012).

Low socioeconomic status is often correlated with unhealthy behavior, reduced access to health care, poor quality health care, and even risk for mortality and morbidity in general (Beckles and Truman, 2011). Socioeconomic status is often defined by education attainment and family or household income (Beckles and Truman, 2011). Because educational attainment can reflect resources, skills, knowledge and behaviors obtained early in life, it can be used as a measurement of how factors in young adulthood can affect factors, such as health, in adulthood (Beckles and Truman, 2011). Many health risks are associated with lower levels of education. These health risks include, but are not limited to obesity, substance abuse, and injury (CDC

Health Disparities, 2012). Individuals with higher education tend to live longer and experience fewer health risks, as well as have better access to health resources (CDC Health Disparities, 2012). Particular health risks such as teen pregnancy, poor dietary choices, inadequate physical activity, and substance abuse can have a direct impact on academic performance which ultimately influences socioeconomic status.

Health disparities involving obesity and overweight, and chronic diseases associated with them are prevalent in the United States. Freedman (2011) reported significant differences in the rates of obesity among racial/ethnic groups, gender, and age. In reviewing the National Health and Nutrition Examination Surveys of 1999-2008, Freedman (2011) reported no racial/ethnic differences in obesity prevalence in females aged 2-5 years, but noted that among females older than 5 years, non-Hispanic Black females had the highest prevalence of obesity followed by Mexican American and non-Hispanic White females. Among males aged 2-19 years, Mexican Americans had a higher prevalence of obesity than whites or blacks (Freedman, 2011). Obesity prevalence was highest in black, non-Hispanic females ages 2-19 years at 24%, with a prevalence of 19% in Mexican American and 14% in White, non-Hispanic women (Freedman, 2011; NHANES 1999-2008). In males ages 2-19 years, obesity prevalence was highest in Mexican Americans, 25%, followed by black, non-Hispanics (18%) and white, non-Hispanic (15%) (Freedman, 2011; NHANES 1999-2008). As summarized by Freedman (2011), the prevalence of obesity as it relates to age and race/ethnicity is listed in Table 2.1.

Table 2.1
Prevalence of Obesity by Age and Race/Ethnicity (Freedman, 2011, NHANES 1999-2008)

Sex	Age (y)	White, Non-Hispanic		Black, Non-Hispanic		Mexican American	
		Prevalence (%)	SE	Prevalence (%)	SE	Prevalence (%)	SE
Female	2-19	14	2	24	2	19	1
	≥ 20	33	1	51	1	43	2
Male	2-19	15	1	18	1	25	2
	≥ 20	32	1	37	2	31	3
Total	2-19	14	1	21	1	22	1
	≥ 20	33	1	44	1	36	2

SE = Standard Error; n = 15,277

The prevalence of obesity is not limited to race/ethnicity and can be linked to household income. Freedman (2011) compared obesity prevalence, race/ethnicity and poverty threshold in 2009. In 2009, the poverty threshold for a family of four was a household income of \$22,050 (Freedman, 2011). Black females had a higher prevalence of obesity independent of household income than did Mexican American or white females ages 2-19 years (Freedman, 2011). Mexican American males had a higher prevalence of obesity than white or blacks within each category of household income (Freedman, 2011).

The National Youth Risk Behavior Survey (YRBS) is conducted every two years during the school spring semester for middle school and high school students. The purpose of the survey is to monitor priority risk and health behaviors that contribute to causes of death, disability, and social problems among youth and adults in the United States (YRBS, 2009). The

survey data represents high school aged students in public and private schools throughout the United States. Under the dietary behaviors category of the survey of 2009, 79.5% of females and 76.1% of males reported eating fruits and vegetables less than five times per day, while 87% females and 85.5% males reported eating vegetables less than three times per day. Sixty-seven percent females and 64.7% males reported that they ate fruit or drank 100% fruit juices less than two times per day. Higher percentages of 91.3% female and 80.2% male reported that they drank less than three glasses of milk per day. However, 23.3% females and 34.6% males claimed they drank a can, bottle, or glass of soda pop at least once per day. A majority of students reported that they were physically active at least 60 minutes per day on less than seven days: females (88.6%) and males (75.5%). When asked about watching television for more than three hours per day, 32.1% females and 33.5% males reported they did. Of the students sampled, 8.3% females and 15.3% males reported being obese, while 15.9% females and 15.7% males reported being overweight.

Health Demographics of DC

In 2007, poor diet and physical activity combined as the second most preventable cause of death (behind tobacco use) in the District of Columbia (DC). The DC Department of Health reported 22.2% of adults 18 years or older were obese, with 28.6% having hypertension and 8.1% having Type II Diabetes (BRFSS, 2010). Health disparities among adults are a concern as they can also indicate disparities among children. Children also look to adults as role models and can develop health behaviors similar to their parents or caretakers. Approximately 18.9% men and 25.1% women are obese in DC (BRFSS, 2010). When breaking down these results by race and ethnicity, the prevalence of obesity in 2007, was 8.9% in non-Hispanic whites, 34.9% non-Hispanic blacks, 21.8% Hispanic, and 10.3% in other races (BRFSS, 2010). Women were

more likely to be obese and suffer from hypertension and diabetes. Residents who have less than a high school education or earn less than \$15,000 per year were more likely to be obese and suffer from hypertension and diabetes (BRFSS, 2010). When comparing the eight wards of DC, there is a noticeable difference in health disparities with Ward 3 having the lowest prevalence of obesity and Wards 7 and 8 having the highest. In Ward 3, the prevalence of obesity, hypertension and diabetes was 11.7%, 20.9% and 3.5%, respectively (BRFSS, 2010). In Ward 7, the prevalence of obesity, hypertension and diabetes was 39.9%, 42%, and 13.8% respectively (BRFSS, 2010).

Upon review of health behaviors of DC residents, women (36%) were more likely than men (29%) to consume the recommended five servings per day of fruits and vegetables (BRFSS, 2010). When broken down by race/ethnicity, non-Hispanic blacks (31%) and Hispanics (29%) were less likely to consume five or more servings of fruit and vegetables compared to whites (35%) and other race/ethnicities (38%). Men were more likely than women to participate in recreational exercise (BRFSS, 2010).

The Youth Risk Behavior Survey data from DC public high schools revealed varying results concerning health-related behaviors and was broken down by race/ethnicity. These results are compared to the Centers for Disease Control Morbidity and Mortality Report of youth risk behavior in nine sites: Delaware, Maine, Massachusetts, Rhode Island, Boston, Chicago, New York City and San Francisco. In Washington, D.C., 17.8% of students grades 9-12 are overweight and 17.7% are obese. These means are slightly higher than the CDC reported means for overweight and obesity in nine sites, 16.1% and 10.6% respectively. Black students (55.5%) reported that they watched more than three hours of television per day compared to Hispanic students (41.9%) and white students (24.8%). These means are higher than the range reported by

the CDC: 24.3-49.6%. Students also reported being physically active at least 60 minutes per day on less than seven days: Black (82.8%), Hispanic (84.4%) and White (80.3%). These means are significantly higher than the range reported by the CDC in nine sites: 11.5-27.3%. Black and Hispanic students reported a higher prevalence of obesity than White students, 15.1%, 15.1%, and 10.3% respectively (YRBS, 2009). When asked about consumption of health foods, 85.7% Black, 86.3% Hispanic and 87.2% White students reported that they ate vegetables less than three times per day (YRBS, 2009).

School Health Policy

Schools can serve as a logical setting for implementing nutrition policies aiming at promotion of healthy diets and undertaking obesity in children (Jaime and Lock, 2009). Policies specific to school wellness and health have been developed to aid in the alleviation of overweight and obese children. Under Healthy People 2020, school-based interventions will be reviewed for their successful and effective components for students in elementary, middle and high school. Goals include increasing the number of states with nutritional standards for foods and beverages provided to preschool-aged children, a 21.3% increase in proportion of schools that do not sell sweetened beverages and a 12% increase in the number of schools required to offer fruits and vegetables when other foods are sold (Healthy People 2020). One of the main objectives of Healthy People 2020 is to reduce the prevalence of obesity in children and adolescents by 9 to 16%, depending on age group, as well as, increase fruit, vegetable and whole grain consumption, and decrease saturated fat and sodium consumption. Thirty-four states have introduced legislation limiting types of foods and beverages sold in schools, paralleling the objectives of Healthy People 2020.

The School Breakfast Program and National School Lunch Program have been permanently implemented into school programs and are re-evaluated every five years. However, many other school nutrition programs must be reauthorized every five years (SNA, 2010). President Obama approved the Healthy, Hunger-Free Kids Act of 2010, which focuses on improving child nutrition and authorizes funding and set policy for the U. S. Department of Agriculture (USDA) core nutrition programs that include: National School Lunch Program, School Breakfast Program, Special Supplemental Nutrition Program for Women, Infants and Children (WIC), Summer Food Service Program and Child and Adult Care Food Program (USDA, 2010). The Healthy, Hunger-Free Kids Act of 2010 allows the USDA to make reforms to the school lunch and breakfast programs and improve critical nutrition and hunger safety for children. In addition to this, the Act provides resources for schools to communicate with local farms and community gardens to get access to fresh produce. More specific to our local area, the Council of the District of Columbia unanimously passed the Healthy Schools Act 2010 with the goals of improving wellness, nutrition and health in public and charter schools in the District of Columbia.

National School Lunch Program

The National School Lunch Program (NSLP) is a federally-assisted meal program through the U.S. Department of Agriculture (USDA) in which healthy meals are provided to public and non-profit private schools and residential child care institutions. Participating school districts and independent schools receive cash subsidies and USDA foods for each meal that is served. Schools must serve lunches that meet federal requirements and free or low-cost meals must be made available to eligible students (USDA NSLP, 2012). Any child at a participating school can purchase a meal through the NSLP. However, only children from families with

income at or below 130% of the poverty level are eligible for a free lunch (USDA NSLP, 2012). Children from families with an income between 130% and 185% of the poverty level are eligible for a reduced-price meal, which cannot exceed 40 cents (USDA NSLP, 2012). The USDA reported for the period of July 1, 2011 through June 30, 2012, families of four who were at 130% of the poverty level earned \$29,055/year while families of four at 185% of the poverty level earned \$41,348/year (USDA NSLP, 2012). Although families earning over 185% of the poverty level pay full price for a meal, the meals are still subsidized where local food authorities set their own prices for full-priced meals while still operating as non-profit programs (USDA NSLP, 2012).

Schools participating in the NSLP receive several forms of support from the USDA. Schools receive cash reimbursements for each lunch served daily. The current cash reimbursement rates for July 1, 2011 - June 30, 2012 are \$2.77 for free lunches, \$2.37 for reduced-price lunches, and \$0.26 for paid lunches in schools that serve less than 60% free and reduced-price lunches during the school year. For schools serving more than 60% free and reduced-price lunches, cash reimbursements are \$0.02 more: \$2.79 free lunches, \$2.39 reduced-price lunches and \$0.28 for paid lunches (USDA Federal Register, 2011). Alaska and Hawaii receive reimbursements slightly higher than DC schools due to higher percentages of low-income students. In addition to cash reimbursement, participating schools are eligible to receive USDA foods at a value of 0.2225 cents for each meal served in the fiscal year of 2011-2012 (USDA NSLP, 2012). States can choose from a list of various foods purchased by the USDA and then offered through the NSLP. The USDA has also worked with schools to help form connections between schools and local farmers to provide fresh produce.

Under the NSLP, school lunches are required to meet nutritional standards of the Dietary Guidelines for Americans. Nutritional requirements include that no more than 30% of an individual's calories are from fat. Less than 10% of the calories can come from saturated fat. NSLP regulations now follow standards that indicate lunches must provide 1/3 of the Recommended Dietary Allowances of protein, Vitamin A, Vitamin C, iron, calcium, and calories (USDA NSLP, 2012). While schools are required to follow the federal nutrition requirements, schools can decide on specific foods and the preparation of these foods.

Healthy Schools Act

In May of 2010, DC passed the Healthy Schools Act (HSA) which promotes the improvement of health and wellness of students attending DC public or public charter schools. The HSA officially went into effect in August of 2010. Under the HSA, free breakfast is available to all DC public and public charter school students (HSA, 2012). Elementary schools where more than 40% of the students qualify for free or reduced-price meals must serve breakfast in the classroom or through other alternative serving models after the day begins. The co-pay once required for children who received reduced-price lunches has now been removed. The Healthy Schools Act encourages local schools to become a *HealthierUS* school at the Gold Level, and changes include, but are not limited to requiring all school meals to meet the Institute of Medicine's nutritional standards for saturated fat, trans fat and sodium. Meals now must include whole grains, a variety of vegetables and fruit, a lower sodium and fat (HSA, 2012). Fresh fruit should be offered at least two days of the week. In order to receive the Gold Award Level, schools must meet or exceed nutritional requirements listed in Table 2.2.

Table 2.2
Nutrient Requirements by the HSA for Gold Award Level (HSA, 2012)

Vegetables	Offer every day Different vegetable each day of week
Fruits	Offer every day Different fruit each day of the week Fresh fruit at least two days/week Juice (100% only) can only count as a fruit 1 day/week
Milk	Offered every day Only fat-free or low-fat
Whole Grains	At least one serving per day
Other Nutrient requirements	Limited saturated fat (fewer than 10% calories) No trans fat Limited sodium with gradual reduction until 2020

In addition to meeting the nutrient standards, schools are required to post information about their meals by posting their menus online or throughout the school and including ingredients and origin of food. The act also requires all competitive foods sold in schools to meet USDA's Gold Level standards, improve school meals by providing an additional 10 cents for each breakfast and lunch meals served, and establish a farm to school program (HSA, 2012). In addition to nutritional requirements, the Healthy School Act also sets a goal of 60-minutes per day of physical activity for students and encourages schools to adopt national standards for physical and health education. Under Title IV of the HSA, schools were required to provide middle school students, grades 6-8, a minimum of 45 minutes of exercise per week, which should then increase to 225 minutes/week by 2014-2015 (HSA, 2012). Health education was another important component of the HSA in which students were to receive a minimum of 15 minutes per week of health education in 2010-2011, which would eventually increase to 75 minutes per week by the 2014-2015 school year. Title VI of the HSA also requires schools to develop a local wellness policy team to promote local wellness. Schools are also mandated to

maintain a tobacco-free environmental and complete a school health profile by February 15th of each school year (HSA, 2012).

Eating Behavioral Studies in Children

With increasing rates of childhood obesity and improvement in the nutrient standards of the National School Lunch Program (NSLP), more recent studies have focused on eating behaviors in children with particular attention to fruit and vegetable consumption. There is some interest in determining if new nutrient standards and school health policy are contributing to improved eating habits, or consumption of healthy foods in students. Cullen et al. (2008) assessed the effect of the Texas Public School Nutrition Policy on middle school students during lunch. Upon analyzing three years of school lunch records self-reported by students, it was determined that consumption of vegetables, milk, protein, vitamins A and C, calcium, and sodium increased, while consumption of sweetened beverages and snacks from competitive foods decreased. In fact, consumption of healthier items of the NSLP was higher after the third year following the implementation of new lunch standards compared to the first year (Cullen et al. 2008). This study indicates that the implementation of a healthy school lunch program can improve students' overall nutrient intake over time.

In a related study, Cullen et al. (2011) compared the results of the Texan Public School lunch study in 2008 with the 2009 Institute of Medicine's school meal report recommendations. Results from this study indicated that children who consumed meals from the NSLP consumed about 1/2 serving of fruit, 3/4 servings of vegetables, 8 oz. of milk, and 1/3 serving of whole grains during lunch. Students who did not consume a meal from the NSLP reported almost no intake of fruit, vegetable or milk (Cullen et al., 2011). About 40% of the children receiving a meal from the NSLP selected and consumed a fruit serving, about 2/3 of the students selected a

vegetable with only 67% consuming it. Less than 4% of the participants consumed a green leafy vegetable (Cullen et al., 2011). Cullen et al. (2011) recommend that interventions will be needed to improve students' food and beverage consumptions with the revised meal standards.

The impact of student socioeconomic status on student lunch consumption in Texan Public Schools was reviewed by Cullen et al. (2009). Lunch consumption patterns of middle school students of middle socioeconomic status and students of low socioeconomic status were explored before and after the Texas Public School Nutrition Policy went into effect. Cullen et al. (2009) reported that students of low socioeconomic status consumed less fat, sweetened beverages, and candy and more vitamin C and calcium than the middle socioeconomic group. However, dietary habits of students of the middle socioeconomic status improved significantly more than students of low socioeconomic status after improved nutritional standards for the NSLP were implemented. Despite this positive behavior change, a significantly higher percentage of students of the middle socioeconomic class reported that they consumed less healthy food items from home after nutritional policies were implemented (Cullen et al., 2009). These results indicate the implications and difficulties of influencing children's consumption patterns throughout the entire school day and outside of the school environment.

Guthrie and Buzby (2002) explored consumption patterns of the school meals by students through a review of plate waste studies. Excessive plate waste from school lunches may indicate that children are not receiving the nutrients offered in school meals. Guthrie and Buzby (2002) reported results from the School Nutrition Dietary Assessment Study-I (SNDA-1). Students participating in the NSLP wasted about 12% of the calories in the food they were served (Guthrie and Buzby, 2002). A difference was observed in boys and girls, where girls wasted 16.6% of calories and boys wasted 9%. In general, younger children tended to waste a higher portion of

their food and nutrients than older children. Children under 11 years old wasted 14.8% of their food, children 11-14 years wasted 11.9% and children over 14 years wasted 6.5% (Guthrie and Buzby, 2002). The most common food type that was wasted was vegetables and salad. These results were compared to an earlier national plate waste study reported by the U.S. General Accounting Office in 1996. The percentage of food wasted in the US GAO study is depicted in Table 2.3.

Table 2.3
Percentage of Food Wasted in School Lunches, US GAO

Cooked Vegetables	42%
Vegetables, Raw Salad	30%
Fresh Fruits	22%
Canned or Processed Fruits	21%
Meat Alternatives	21%
Meats	14%
Breads/Grains	13%
Milk	11%

The US GAO attributed the generation of high plate waste to children focusing on free time and recess rather than eating, dislike for the food, dislike for the way food looked or tasted, not enough time to eat, not hungry, or servings being too large (Guthrie and Buzby, 2002). Guthrie and Buzby (2002) made several recommendations to improve consumption of school lunches: improving selection of commodities donated by the USDA, increasing use of local foods and produce and increasing student input. Nutrition education is also suggested to improve students' knowledge and familiarity with school lunches.

More recently, studies have discussed children's consumption patterns of school lunches with particular attention given to methods of increasing nutrient intake through various methods such as nutrition education (Gundersen et al., 2012; Rozin et al., 2011; Schaub and Marian, 2011; Gleason and Dodd, 2009). There are mixed reviews as to whether the NSLP has and will be successful in promoting healthy eating habits in children. Schaub and Marian (2011) review the NSLP and physical education programs in schools and encourage schools to revise their health-based education curriculum as the NSLP and current physical education components have failed to alleviate the obesity epidemic in children. Gundersen et al. (2012) concluded that children participating in the NSLP, specifically those receiving free or reduced-price lunches, tended to have worse health outcomes than those children not participating in the NSLP. However, they attributed this mainly to food security issues outside of the school environment. When self-reporting error is considered Gundersen et al. (2012) saw that the NSLP was not associated with poor health and obesity. Gleason and Dodd (2011) conclude that there is no evidence that the NSLP contributes to a rising prevalence of obesity. Clearly, there are discrepancies as to whether the NSLP has had a positive or negative influence on children's health and eating behaviors and more research is needed.

Summary

Although much attention has been given to the adult obesity epidemic in the United States, the consistent increase in childhood obesity rates have drawn attention to the health of future generations. With the development of technology, children are living more sedentary lifestyles and are continuously exposed to processed foods and fast food restaurant meal options. A diet high in fat, sugar and sodium combined with low levels of physical activity can result in weight gain and health problems associated with being overweight or obese. Because children

spend a large part of their day in school, introducing children to nutritious meals while increasing their physical activity levels can play a key role in diminishing the obesity epidemic among children in the U. S. School health policies have aimed at providing healthy meals and lifestyles to students. Specifically, the Healthy Schools Act (2010) was implemented in the District of Columbia to improve students' health, including providing nutritious meals throughout the school day. This study describes the consumption patterns of the new healthy school lunches by middle school students. It is hoped that data from this study can be applied to develop methods to enhance children's consumption of the fruits and vegetables.

CHAPTER 3

RESEARCH METHODOLOGY

Overview

This chapter will describe the research methodology used to study consumption patterns of school lunches under the Healthy Schools Act of 2010 of a middle school in Ward 3 and a middle school in Ward 7 in the District of Columbia. This section provides a description of the demographics of the two participating middle schools and sample size of participating subjects. Project design and procedure, data collection methods, and data analyses procedures are also summarized.

School Demographics

Alice Deal School and Kelly Miller School are located in two distinctive Wards in Washington, D.C. Table 3.1 provides a summary of demographic information and a comparison between Ward 3 and Ward 7.

Table 3.1
Demographic Comparison of Ward 3 and Ward 7 (neighborhoodinfodc.org, 2011)

	WARD 3 (Alice Deal School)	WARD 7 (Kelly Miller School)
Population (2010)	77,152	71,068
	13% children under 18 years	25% children under 18 years
Poverty Level (2005-09)	6.9%	26%
Children in poverty (2005-09)	3.1%	40%
Avg. family income per year	\$257, 386	\$54,677
Majority Racial Group Composition	78%White	96% Black

Alice Deal School consists of grades 6-8 and is located in Ward 3 of the District of Columbia in the northwest region. Ward 3 has a population of 77,152 (2010), of which 13% are children under 18 years old. Ward 3 is characterized with a poverty level of 6.9% (2005-09) with 3.1% of

children of Ward 3 living in poverty. The average family income is \$257, 386 per year. The racial composition is majority non-Hispanic White (78%), while Black non-Hispanic, Hispanic and Asian or Pacific Islander represent equal, yet much smaller percentages.

Kelly Miller School consists of grades 6-8 and is located in Ward 7 of the District of Columbia on the boarder of the northeast and southeast region. Ward 7 has a population of 71, 068 (2010) of which 25% are children younger than 18 years. Ward 7 is characterized with a poverty rate of 26%, in which 40% children are living in poverty. The mean annual household income is \$54,677. The racial composition is majority Black non-Hispanic (96%) with much smaller percentages of Hispanic, White non-Hispanic, Asian and Pacific Islander.

Approximately, 923 students are enrolled in grades 6-8 of Alice Deal School. Kelly Miller School has 379 students enrolled in grades 6-8. In 2011, 84% and 83% of Alice Deal School students met or exceeded the math and reading DC CAS standards, respectively, while 29% and 23% of Kelly Miller School students met or exceeded the math and reading DC CAS standards, respectively. Alice Deal School supports 8% of the student population in special education needs, while Kelly Miller School supports 23%. Approximately, 61% of Alice Deal School students are in-boundary, which includes students who attend their neighborhood school as determined by where they live. Kelly Miller School is comprised of 88% in-boundary students. The two schools have different racial and ethnic compositions. Table 3.2 summarizes and compares the racial composition at each school.

Table 3.2
Student Race Statistics (2010-2011)

	Alice Deal School (%)	Kelly Miller School (%)
Black	37	99
White	39	0
Hispanic	13	1
Asian	6	0
Pacific Islander	0	0
Native Indian/ Alaskan Native	0	0
Multiple Races	5	0

DC Central Kitchen served 334,000 healthy meals schools in the District of Columbia in 2011.

DC Central Kitchen is responsible for serving breakfast, lunch and dinner at seven schools in the District of Columbia, which includes both Alice Deal School and Kelly Miller School. At Alice Deal School, 23% of the students receive school meals at a free or reduced price, while 86% of the students at Kelly Miller School receive school meals at a free or reduced price.

Subjects

Table 3.3
Number of Lunch Trays Observed

Date	Grade	DEAL	KMS
27 Feb. 2012	6	68	67
	7	92	75
	8	57	72
	Total	217	214
28 Feb. 2012	6	48	71
	7	92	80
	8	59	57
	Total	199	208
29 Feb. 2012	6	113	69

	7	115	57
	8	106	53
	Total	334	179
1 Mar. 2012	6	87	78
	7	83	65
	8	78	51
	Total	248	194
2 Mar. 2012	6	45	84
	7	72	81
	8	78	63
	Total	195	228
5 Mar. 2012	6	87	88
	7	110	65
	8	80	72
	Total	277	225
6 Mar. 2012	6	82	77
	7	100	75
	8	90	69
	Total	272	221
7 Mar. 2012	6	70	74
	7	77	60
	8	62	58
	Total	209	192
8 Mar. 2012	6	60	78
	7	80	68
	8	68	46
	Total	208	192
9 Mar. 2012	6	79	74
	7	87	68
	8	79	65
	Total	245 (cut apple n=187)	207

Design

This study measured consumption of raw and cooked vegetables and fresh fruits served at school lunch through analyses of plate waste. Food consumption patterns were compared between two middle schools consisting of students of different socioeconomic backgrounds. This study investigated differences in consumption of fruits and vegetables of the school lunch

between students at a DC public middle school in Ward 3 and Ward 7, as well as differences in consumption of cut fruit versus whole fruit were also described.

Procedure

Prior to Data Collection

Prior to data collection, separate meetings were held with the Principal from Kelly Miller School and the Vice Principal from Alice Deal School. The school administrators were informed of the proposed data collection and research methodology. A meeting was also held with DC Central Kitchen staff for each of the two schools in order to coordinate foods of interest for this study and intervention methods. In collaboration with DC Central Kitchen, we received approval from both schools to perform the two week data collection. In addition to receiving approval from the schools' administrations and due to the limited interaction with students during data collection, this project also received approval from American University Institutional Review Board.

Data

V-Project, Smartphone Application

The V-Project smartphone application was developed by graduate student from Brigham Young University. V-Project was specifically developed for the collection of food consumption patterns and plate waste data with minimal impact on student behavior as data can be collected without direct interactions with students. Prior to each day of data collection the user must enter basic information about the school: school name, collector name, description of what is being recorded (such as "lunch"), fruit and vegetables offered, daily entrees, other food items, and any

notes the user needs to make about the data collection. Each school or collection site can also be assigned a number for tracking.

After setting up the daily file for data collection, the user then takes a position in the area where students are disposing their waste. The data collector must then observe each student's tray and record the portion of each pre-designated food item consumed by the student. When recording data using V-Project, the user can select and set the grade, gender, and entree chosen by each student. Fruits, vegetables and other tracked items are also selected if the student also selected the item. There are no fruit and vegetable alternatives available for students; however, students can elect to not have an item placed on their food tray. For each food item selected, the user then selects "0," "0.5," or "1.0" to indicate the portion 0%, 50%, or 100%, respectively, consumed by the student. The user then hits submit and can repeat this process several times to record consumption patterns for all subjects. Upon completion of data collection each day, all of the data was emailed in the form of an excel spreadsheet which was imported directly into STATA for data analyses. Figure 3.1 displays a screenshot of the V-Project iPhone application data collection screen where the user can enter the grade level, gender, choice of entrée, and items tracked.

Sampler					
1	2	3	4	5	6
Boy		Girl			
Beef taco...		Va			
Bana...	0	.5	1		
Beef...	0	.5	1		
Corn	0	.5	1		
Submit					

Figure 3.1. Screenshot of the V-Project iPhone application. In this example “1” was assigned to represent sixth grade. The screen shows a sixth grade boy who chose the beef taco for his entrée and ate 100% of the banana and beef taco, and 50% of the corn.

Food Items Tracked

DC Central Kitchen is the food service provider for Alice Deal School and Kelly Miller School. Both schools featured the same lunch items for the hot meals and fruits and vegetables. A vegetarian option is also available. Students receiving meals from the hot meals food service line are provided food items that are pre-portioned and each student receives the same portion of each item. Students can choose to not to receive any of the provided food items. However, a majority of the students are provided a tray with all of the daily food items. The monthly lunch menu is posted on each school's website at the beginning of the month. Prior to data collection, three food items per day were designated as items to track for consumption pattern measurement. Food items tracked during the two week study period are listed in Table 3.4.

Table 3.4 Daily Lunch Food Items Tracked

February 27, 2012	Crispy Fish Sandwich Cole Slaw 100% Grape Juice
February 28, 2012	Jerk Chicken Strips Local Collard Greens Fresh Banana
February 29, 2012	Beef Taco Steamed Corn Cantaloupe Wedge
March 1, 2012	Baked Macaroni and Cheese Spinach Salad Whole Apple
March 2, 2012	Turkey Ham and Cheese Sandwich Baby Carrots Orange Wedges

March 5, 2012	Beef Hot Dog BBQ Baked Beans 100% Grape Juice
March 6, 2012	Baked Chicken Drum Sweet Potatoes Fresh Pear
March 7, 2012	Corn Crusted Catfish Buttered Peas Orange Wedges
March 8, 2012	Baked Ziti with Mozzarella Cheese Collard Greens Fresh Banana
March 9, 2012	Orange Glazed Chicken Steamed Broccoli Cut Apple

Data Collection

Data was collected over ten consecutive school days with plate waste observations commencing on February 27, 2012 and ending on March 9, 2012. Data was collected at Kelly Miller School and Alice Deal School concurrently during each of the grade level lunch periods. A lead researcher was assigned to each school and was present for all ten days of data collection to decrease variability in data collection. Assistant research team members aided in data collection by organizing students so that the researchers could observe the students' lunch trays. Due to the smaller number of students and lunch period structured routine only one lead researcher and no assistant researchers collected data at Kelly Miller School. Alice Deal School is almost twice the size in regards to number of students; therefore, one lead researcher was assigned with one assistant researcher for the ten days of data collection.

Kelly Miller School has a regimented routine led by faculty members during the lunch period where students line up to receive their lunches by table. Because of the organized

structure of the lunch period, students ultimately consume their lunches at varying times during the period and there is no rush of students at the trash cans disposing their lunch trays. An adult brings the trash can to each table as students dispose their trays one at a time. This allowed an ample opportunity for plate waste observations, as well as time to enter data into the V-Project application. This process also ensured that there was no overlap of data collection of counting students more than once.

The Kelly Miller School students are limited to one type of hot meal and can purchase snacks. This study only measured food items listed in Table 3.4. There is no salad bar option available at the school. However, the daily lunch menu also included a vegetarian option for students and only 1-2 students choose this option. This study did not include measurements of consumption of the vegetarian option.

Alice Deal School also follows a regimented routine for the three grade level lunches, all of which are led by faculty members. Students are permitted to receive their lunches from the hot meal lunch line one table at a time. However, there is also a salad bar line option where students can chose between the hot meal of the day and salad bar. Students are limited to one type of hot meal and can purchase snacks. A vegetarian option is available and we did not track this option. Unlike Kelly Miller School, students dispose of their own lunch trays into one of the six garbage cans at the front of the cafeteria. Due to the orderly conduct during the lunch period, students periodically dispose of their lunches to avoid a rush of students at one garbage can at one time. In order to ensure that research leaders only measured plate waste from trays from the hot meal lunches and not the salad bar, two garbage cans were designated as "salad bar trays only" garbage cans and four cans were designated at "hot meal trays only" as designated by signs. Prior to data collection, faculty members practiced with the children to ensure they

understood which can to properly dispose their lunch. Children who brought their own lunches were able to dispose of their waste in any of the garbage cans and were not measured.

The same protocol for data collection using the V-Project smartphone application was used by the lead researchers at both Alice Deal School and Kelly Miller School. As students disposed of their trays, lead researchers recorded the amount of each designated tracked food item for the day using the V-Project application. At the end of the final lunch period of each day, the data was emailed in an Excel file to the lead researcher using the V-Project application.

Data Analysis

Descriptive statistics utilizing means were expressed as percentages of students who consumed fruits and vegetables. In order to answer the first research question addressing the issue of describing consumption patterns of fruits and vegetables by middle school students, the data from both Alice Deal School and Kelly Miller School were aggregated. From this data set, means were expressed as percentages of all sampled students who consumed fruits, raw vegetables and cooked vegetables. To address the second research question, data was separated by school to show the percentage of students who consumed all, half or none of the fruit, raw vegetables or cooked vegetables at each of the middle schools. The difference in consumption patterns between Alice Deal School students and Kelly Miller School students was tested using a paired t-test with statistical significance set at the $p < 0.05$ level.

A relationship between similar fruits that were paired with different entrees was investigated using aggregated data from both schools. Descriptive statistics were used to express the percentage of students who consumed each of the fruit items when paired with a different entrée. The fruits were then compared using a paired t-test with statistical differences set at the $p < 0.05$ level.

The third research question investigated a difference in the consumption of a whole versus cut apple for all middle school students. Means showing the percentage of students who consumed half or all of the cut apple and the whole apple were compared using t-tests with a statistical significance set at the $p < 0.05$ level.

Data was analyzed using STATA statistical software, and graphs and tables were created in Microsoft Excel.

CHAPTER 4

RESULTS AND DISCUSSION

Overview

This chapter reviews the results from the data analyses of the three research questions for this project. The initial research question entailing an overall description of student consumption of fruits and vegetables will first be addressed. From this data set, consumption patterns of the fruits and vegetables by students at Alice Deal School and Kelly Miller School are compared to each other. The third research question addressing a difference in students' consumption rates of a whole versus a cut apple are addressed. Results are first presented followed by a discussion and analyses of data.

Results

Middle School Student Consumption Rates of Fruits and Vegetables

The first research question of this study investigated the percentage of fruits and vegetables consumed by middle school students of Alice Deal School and Kelly Miller School. All data collected at each of the schools was combined so that data of students of all ages and gender from both schools was aggregated. During the ten-day data collection, a total of 4,464 lunch trays were observed with 2,404 observations at Alice Deal School and 2,060 observations at Kelly Miller School. Alice Deal School has 923 students attending the school of which 23% receive a free or reduce-priced lunch. This percentage of students would equal 2,122 trays over a ten-day period. Since we measured 2,404 lunch trays, 282 additional trays were measured in addition to the potential number of trays coming from students receiving free or reduce-priced lunch. At Kelly Miller School, 86% of the 379 attending students receive a free or reduce-priced lunch, which would equal a total of 3,259 potential trays for observation over the ten-day study.

By measuring only 2, 060 trays, this study includes approximately 63% of the potential lunch trays from students receiving free or reduce-priced lunch.

Table 4.1 displays the types of fruit and vegetables that were offered during the two-week study. Six different fruits were offered with four of the fruits (apple, banana, grape juice, and orange wedge) being offered twice during the two-week period. Nine different vegetables were offered, and only one of those nine vegetables (collard greens) was repeated during the study. Three vegetables were raw (baby carrots, cole slaw and spinach salad) and the other six vegetables offered were cooked.

Table 4.1 Fruits and Vegetables Offered During the ten-day Study

Fruits	Raw Vegetables	Cooked Vegetables
Apple*	Baby Carrots	BBQ Baked Beans
Banana*	Cole Slaw	Buttered Peas
Cantaloupe	Spinach Salad	Collard Greens*
Grape Juice*		Steamed Broccoli
Orange Wedge*		Steamed Corn
Pear		Sweet Potato

* Item was served twice (two separate days) during ten-day study

Figure 4.1 illustrates that a statistically significant ($p < 0.05$) higher percentage of fruits were eaten when compared to vegetables. Sixty-six percent servings of fruit were consumed compared to 54% and 46% of tasted or entirely consumed servings of raw and cooked vegetables, respectively. A statistically significant ($p < 0.05$) higher percentage of the raw

vegetables were consumed when compared to cooked vegetables.

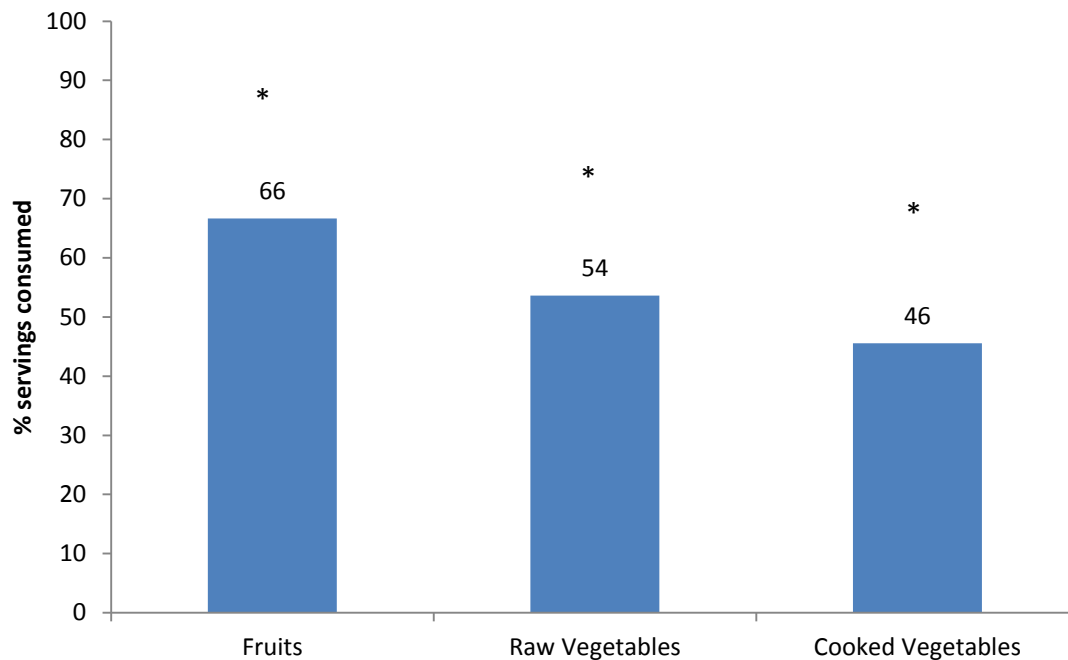


Figure 4.1 Percentage of Servings of Fruits and Vegetables Consumed (n = 4,464)

Student Consumption Patterns: Alice Deal School vs. Kelly Miller School

The second research question investigates if there is a difference in consumption patterns between Alice Deal School students and Kelly Miller School students. The first hypothesis stated that there will be no difference in the consumption patterns between Alice Deal School students and Kelly Miller School students. Table 4.2 summarizes the food consumption rates at both Alice Deal School and Kelly Miller School. The data represent the percentage servings consumed by students at each school who consumed the entire food item (whole), half or at least tasted the item (half) or did not eat any of the item (zero) for all fruits, raw vegetables and cooked vegetables. At Alice Deal School, a total of 2,404 lunch trays were observed, while 2,060 lunch trays were observed at Kelly Miller School.

Table 4.2 Percentage of Fruits and Vegetables Consumed by Students

Servings are indicated as whether students consumed whole, half, or none of the fruits, raw vegetables, and cooked vegetables during the school lunch at Alice Deal School and Kelly Miller School.

	Whole (%)		Half (%)		Zero (%)	
	Deal	Kelly Miller	Deal	Kelly Miller	Deal	Kelly Miller
Fruits	49.1	59.41	10.18	15.78	40.72	24.81
Raw Vegetables	24.11	21.38	28.3	33.49	47.59	45.13
Cooked Vegetables	28.56	26.19	16.8	19.59	54.64	54.22

The first hypothesis stated there would be no difference between the consumption patterns of students from each school. The percentage of Alice Deal School students who consumed fruits, cooked vegetables and raw vegetables were 59.27%, 45.36%, and 52.41%, respectively. The percentage of Kelly Miller School students who consumed fruits, cooked vegetables and raw vegetables were 75.19%, 45.79%, and 54.87%, respectively. From observations of the school lunch fruits and vegetables, students at both schools observed similar quantities of food during the two-week study. However, Kelly Miller School students consumed a statistically significant ($p < 0.05$) higher amount of fruit than students at Alice Deal School. There was no statistical difference ($p > 0.05$) in consumption of raw or cooked vegetables in Alice Deal School students and Kelly Miller School students. Figure 4.2 graphically displays the comparison of fruit and vegetable consumption of Alice Deal School students and Kelly Miller School students.

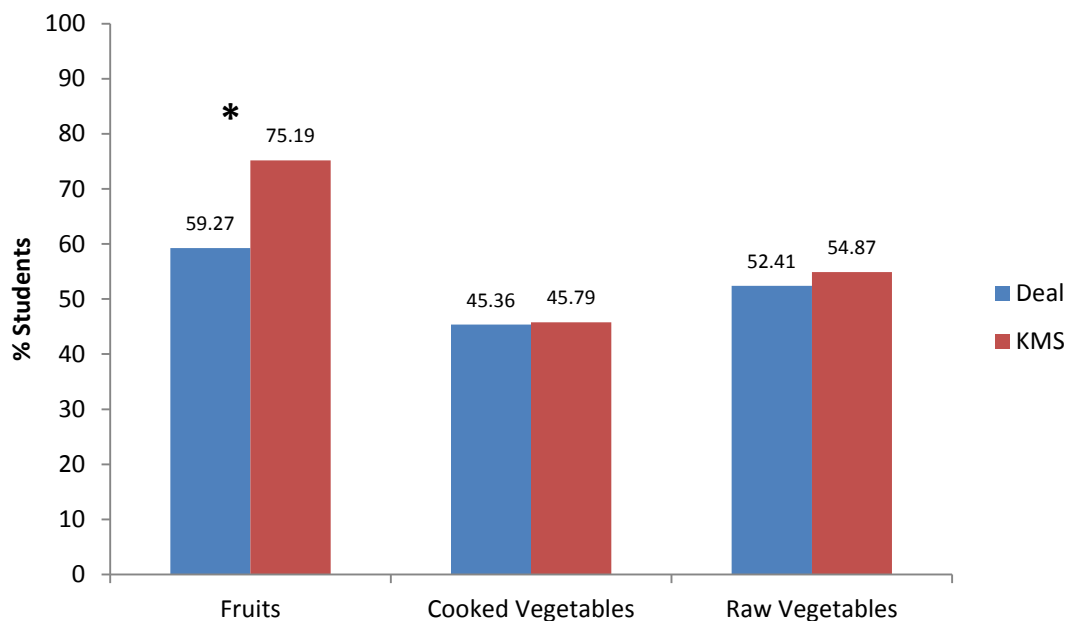


Figure 4.2 Comparison Students who Consumed Fruits and Vegetables
(Alice Deal School, n = 2,404; Kelly Miller School n = 2,060)

Because some fruits were repeated during the two week study, consumption of these fruits were investigated further to see if the type of entrée they were paired with had any effect on the students' consumption rate of that fruit item. All student data from both schools was aggregated. Bananas were served with beef tacos on one day, and baked ziti on another day. Grape juice was served with a fish sandwich and a hot dog, and orange wedges were served with a turkey sandwich and catfish entrees. For the banana, 80.5% of the students consumed the item when it was paired with beef tacos, while only 67% consumed the item when it was paired with baked ziti. In this case, a statistically significant percent of students ate more of the banana on the day it was served with the beef taco entrée. There was no significant difference in consumption patterns for grape juice when it was served with a fish sandwich (89.5%) or hot dog (89.04%). There was no significant difference in students' consumption of the orange wedges when they were served with a turkey sandwich (80.79%) or catfish (84.79%) entrees. Figure 4.3 summarizes these findings.

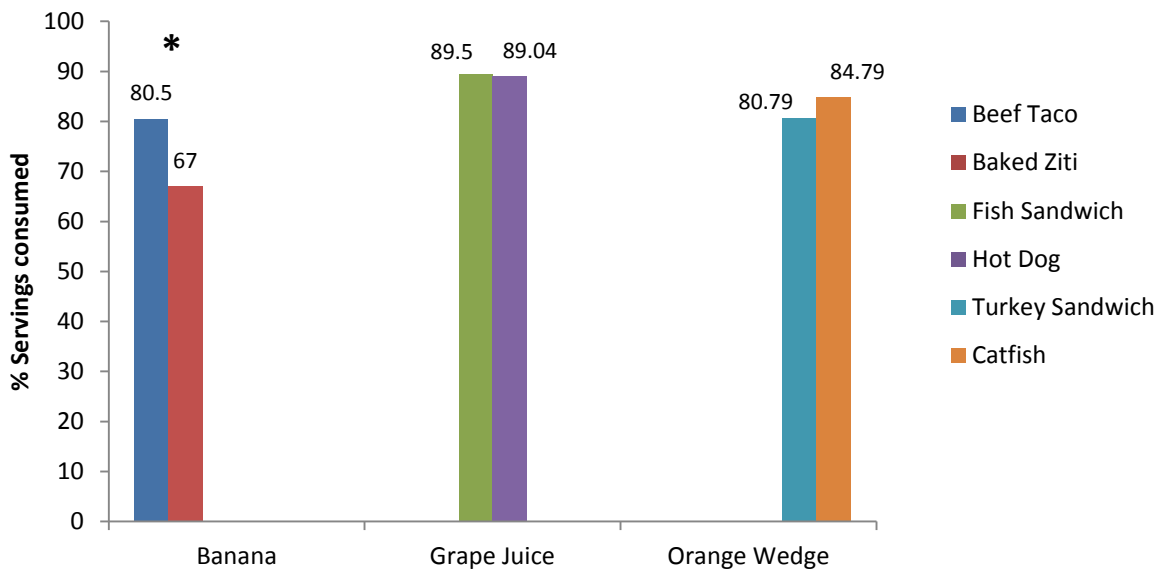


Figure 4.3 Percentage of Fruits Consumed when Paired with Different Entrées

Middle School Students' Consumption of Whole Fruit Versus Cut Fruit

The final research question investigated middle school students' consumption of whole fruit versus cut fruit. The second hypothesis stated that there would be no difference in students' consumption of whole versus cut fruit. In this study a whole apple was provided during the first week of the study, while a sliced apple was provided during the second week of the study. Samples from both schools were aggregated and it was determined that 28.98% of the students consumed the cut apple, while 41.4% of the students consumed the whole apple. A significantly larger ($p < 0.05$) number of students consumed the whole apple. Figure 4.4 summarizes these analyses.

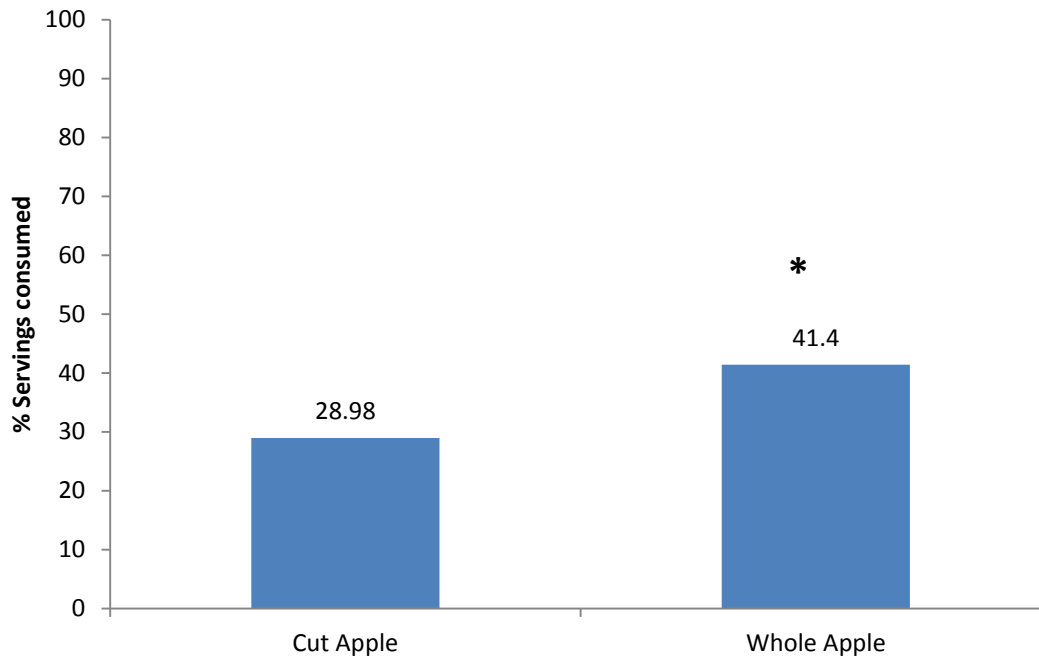


Figure 4.4 Percentage of Students who Tasted or Consumed a Cut or Whole Apple

To investigate the consumption of the whole versus cut apple further, we investigated the percentage of students who consumed the entire (whole) item (whole apple or cut apple) and the percentage of students who ate half or at least tasted (half) the item (whole apple or cut apple). For the whole apple, 15.71% students consumed the entire item and 13.27% consumed half of it or at least tried it. For the sliced apple, 19.46% students consumed the entire item and 21.95% students consumed half or at least tasted their sliced apple. A significantly ($p < 0.05$) larger percentage of students tasted, consumed half or the entire whole apple compared to the sliced apple. Figure 4.5 summarizes these results.

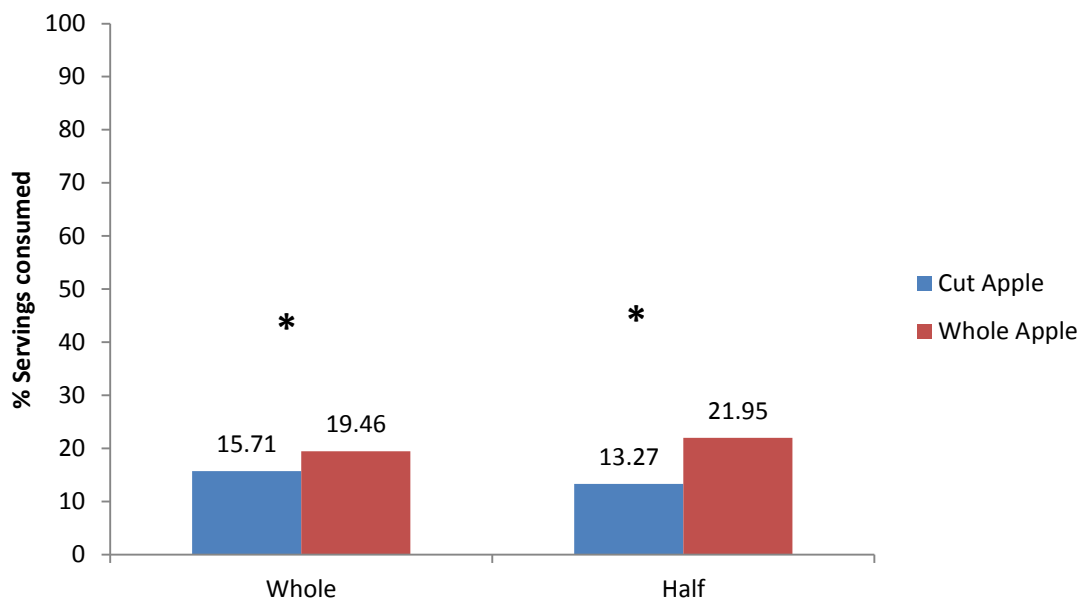


Figure 4.5 Percentage of Students who Consumed All or Half of a Cut or Whole Apple

Discussion

The three research questions of this study explored consumption patterns of the fruits and vegetables provided in the school lunches by middle school-aged children. The first research question aimed to describe the general eating habits, with particular attention to consumption of fruits and vegetables, of middle school children from two distinctly different public schools in the district. The second and third research questions explored consumption patterns of middle school students in more detail by aiming to identify significant differences in eating habits between students of middle schools located in two different DC Wards, as well as whether students' consumption of fruits would be influenced if fruit was served whole or sliced.

Middle School Student Consumption Rates of Fruits and Vegetables

When looking at consumption patterns of the items served in the school lunches, these results indicate that middle school students consume more fresh fruits (66%) than cooked (46%)

or raw vegetables (54%). Students generally prefer fresh fruits and possibly prefer them over non-fresh fruit items, such as pineapple or peach fruit cups. Children tend to prefer the taste of sweeter items such as fruits over vegetables that may taste bland, bitter or even sour. Previous studies have indicated students' preference for fruits over vegetables due to their sweeter flavor (Cullen et al. 2005; Molaison et al. 2005). Results from this study correspond to other studies summarizing student consumption patterns of school meals in which students were more likely to consume more fruits than vegetables (Navalpotro et al., 2012; Rosario et al., 2012; Condon et al. 2008; Guthrie and Buzby, 2002; Birch and Fisher 1998). One study reported that children will not consume healthy foods that include grapefruit, tomatoes, peas, and cooked carrots because of their bland or sour taste (Power et al, 2010). An increase in fruit and vegetable availability in school meals does not necessarily lead to increase in consumption of these items by students (Condon et al., 2008).

Provisions of the Healthy Schools Act mandate that D. C. schools provide a different fruit and vegetable each day with lunch to increase students' exposure and access to healthier foods. As fruits and vegetables are made more readily available to students as a result of school health policies, it does not guarantee that students are consuming them. In this study, 34% of the fruit was discarded and many of the vegetables, served raw or cooked, were not consumed. Only 54% of raw vegetables and 46% of the cooked vegetables served were consumed or at least tasted by students. These observations correspond to work by Condon et al. (2008) who noted that a large portion of students in their study did not consume vegetables, especially dark-green vegetables, orange vegetables, and legumes. Unfortunately, there was no data collected prior to the implementation of the Healthy Schools Act that could be used to understand if consumption

patterns have been impacted by the implementation of the new nutrient standards for school lunches.

Student Consumption Patterns: Alice Deal School vs. Kelly Miller School

The second research question investigated the difference in consumption patterns of fruits and vegetables of students from two different public middle schools. Kelly Miller School students consumed slightly more cooked vegetables (45.79%) and raw vegetables (54.87%) than Alice Deal School students (45.36% and 52.41% respectively). A significantly higher percentage of students at Kelly Miller School (75.19%) consumed more fruit than the Alice Deal School students (59.27%). Alice Deal School is located in Ward 3 of the District and is primarily composed of a higher socioeconomic class as compared to Ward 7, the location for Kelly Miller School. It was initially speculated that the students of Alice Deal School would consume more fruits and vegetables due to their familiarity with food items and potential exposure to these items at home more often than students of Kelly Miller School. However, there are several limitations that this study must consider when comparing consumption patterns between the students at each school. The sample sizes of each school were similar despite the fact that Alice Deal School has almost three times the number of students as Kelly Miller School. Because 23% of the Alice Deal School students receive a free or reduce-priced lunch, it is possible that a majority of the samples came from this portion of the population at Alice Deal School and may also indicate that these students are of the same socioeconomic status as Kelly Miller School students. Because no information about each particular student was collected, this study cannot necessarily determine the level of similarity or difference between these two populations. For the purpose of this study, this section will include a discussion of factors that have been reported to influence children's consumption of fruits and vegetables.

Influences on Children's Eating Habits

The question as to what are the confounding influences on children's eating habits still remains complicated despite that adolescents have been shown to understand the role of lifestyle factors in health in regards to healthy eating (Power et al., 2010). Determining the exact factors that influence eating behaviors in children is beyond the scope of this project. This section explores several influences on consumption rates that have been discussed in the literature to date. These influences include parental and familial health and eating habits, participation in the National School Lunch Program, health disparities, pairing of food items, and school environments and nutrition education.

Parental and Familial Influences on Children's Eating Behaviors

Parents highly influence their children's eating behaviors, feeding practices and even mediate familial patterns of overweight just through their own health behaviors (Birch and Davidson, 2001). A higher rate of obesity, correlated with poor eating habits, has been shown to be influenced by environmental factors such as parents' level of education, obesity in family members, and family member's health habits (Weker, 2006). Navalpotro et al. (2012) reported a prevalence of obesity 1.45 times higher in children living in lower socioeconomic areas than those living in higher socioeconomic areas. Disparities between the two populations of Alice Deal School students and Kelly Miller School students are apparent, as Ward seven (Kelly Miller School School) has a higher prevalence of obesity and a larger percentage of Kelly Miller School students receive free or reduce-priced lunches and score lower on academic achievement tests. While these differences exist, students' socioeconomic status, eligibility for free or reduce-priced lunch and scholastic achievement were not recorded when consumption rates were observed. Whether the socioeconomic status and scholastic achievement of the sample group from Kelly

Miller School is significantly different from students at Alice Deal School is unknown. A majority of the observations of lunch trays at Alice Deal School (2, 122 trays of the 2, 404 observed trays) most likely included children who were eligible for a free or reduce-priced lunch and the sample population from each school may not be as different as originally expected. Despite the different disparities between Kelly Miller School students and Alice Deal students that have been noted, students' eating habits were relatively similar when provided the same menu or meal options.

Participation in the National School Lunch Program

Because the obesity rate of Ward 7 (Kelly Miller School) is higher than Ward 3 (Alice Deal School), it was originally thought that this information would be connected to the consumption rates of the students. In addition to Ward demographics, 86% of the students at Kelly Miller School and only 23% at Alice Deal School receive a free or reduced-price lunch. Children receiving free or reduced-priced lunches through the National School Lunch Program have been shown to have worse health outcomes on average than children who do not participate (Gunderson et al., 2011). Participation in the National School Lunch Program and its relationship to childhood obesity has been a concern (Paxton et al., 2012; Clark and Fox, 2009; Ralston et al., 2008). Studies have concentrated on exploring the existence of a relationship between obesity and participation in the school breakfast and lunch programs. Prior to new nutrient standards for school meals, published studies presented conflicting viewpoints or inconclusive results as to whether participation in the National School Lunch Program (NSLP) was positively or negatively correlated with childhood obesity (Ralston et al., 2008). Many of these studies differed in data collection methods, statistical analyses, sample size, consideration of a la carte food items, and percentage of participants receiving free/reduce-priced lunches (Ralston et al.,

2008). Lack of consistency among studies has inevitably resulted in inconclusive results when attempting to describe the relationship between participation in the NSLP and obesity.

A higher percentage of participation in the NSLP at Kelly Miller School and the more likely chance that Kelly Miller School students suffer from food insecurities and lack access to healthy foods may be contributing factors to why these students consume more of the school lunch. Other studies have shown that students who qualify for free or reduced-price lunch self-report they consume more fruits and vegetables while in school (Wordell et al. 2012). Students who qualify for free and reduced-price school meals have been reported to consume more milk and juice in school than outside school, more candy and energy drinks in school and more sweet drinks, candy, pastries and energy drinks outside of school (Wordell et al., 2012). Results from this study are similar to a study of the Texan Public School system in which children of low socioeconomic status were reported to consume more healthy lunches at school compared with middle socioeconomic status students (Cullen et al., 2009).

The Pairing of Food Items

Following analyses of fruit consumption, it was noted that significantly different percentages of servings of bananas were consumed when the fruit was served with two different entrees. This observation raised the question as to whether “pairing of food” could impact consumption rates of the fruits during the school lunch. Four fruit items were repeated and served with a different hot meal during the two-week period which allowed for further exploration of the impact of pairing food items. Of those four fruit items, apples were repeated but served differently each time (whole and sliced) for an intervention. The three remaining fruits that were repeated included a banana, orange wedges and grape juice. Consumption rates of grape juice were high (89% of the students consuming the item) each time the item was

offered and there was no significant differences in consumption rates when served with different entrees. The same results were observed in orange wedges; however, consumption rates were slightly lower (80-85%). Consumption rates of bananas were significantly higher when they were served with a beef taco than when they were served with baked ziti. In this case, the banana was paired with two different types of entrees which may indicate that the type of food served with the fruit item may influence how much of the fruit students consume. It is possible that after consuming an entrée such as baked ziti, students are full and less likely to want to eat their banana. Grape juice and orange wedges were paired with entrées of similar portion sizes and easier to consume, which could account for why consumption rates of the fruits were similar.

School Environments and Nutrition Education

School environments and education programs were additional factors that need to be considered when studying children's eating habits. In this study, a majority of the observations came from students who received a free or reduce-priced lunch that may indicate that most of the students came from a similar socioeconomic status. However, consumption patterns could have also been influenced by the difference in the two school environments. Kelly Miller School students do not receive recess during the school day, which may have provided them with more time and less need to rush during the lunch hour, thus resulting in higher consumption rates of the school lunches. During the lunch hour, Kelly Miller School students are released by table to receive their lunch, allowing longer time for some students to consume their meal, and much shorter time for those students who receive their meal last. Alice Deal School students are permitted to go outside for recess once they are finished with their lunches and their tables are cleared of trash. This could result in students rushing to eat only portions of their lunches or even students feeling pressured from their peers to finish lunch quickly so that they can play outside.

Education opportunities in Alice Deal School and Kelly Miller School could not be standardized for this study. Many of the students at Kelly Miller School had not received any health education until this year. However, about half of the students participated in a health and nutrition six-week program in addition to their first semester of health education prior to data collection for this study. It is possible that information learned in the health programs could result in students consuming more fruits and vegetables. Alice Deal School students did not participate in the same six-week health and nutrition program as the Kelly Miller School students, yet their significantly higher achievement scores in reading and math indicate these students have been exposed to better education opportunities than Kelly Miller School students. Varying education opportunities, school schedules, and percentage of students in the study sample receiving free or reduce-priced lunches are all limitations for this study.

Behavioral Economic Strategies: Consumption of a Whole Apple Versus a Sliced Apple

Behavioral economic strategies such as changing a physical environment or improving accessibility to certain food items have been implemented to promote healthy eating in children. The final research question of this study incorporated a behavioral economic strategy that involved an intervention with the intention of nudging students to taste or consume more fruits. In this study, a whole apple was served one week and a sliced apple was served the following week. It was originally speculated that students would prefer the sliced apple over the whole apple, as whole apples may be difficult to hold and bite into for younger children. The results from this study indicate otherwise showing that a significantly larger percentage of students (41.4%) consumed the whole apple over the sliced apple (28.98%). To explore this further, we investigated the percentage of students who consumed the entire fruit item (whole apple and sliced apple) and those who consumed only half of or at least tasted (few bites) the apple. In

both cases, a significantly higher percentage of students preferred the whole apple. In other words, more kids ate the entire whole apple and even tasted the whole apple over the sliced apple option. This was surprising because it was speculated that sliced fruit would be easier for the students to hold and consume, especially when 80-85% of the students consumed the sliced orange wedges in other school lunch meals. However, preparations may have served as barriers to student consumption of the sliced apples. Over time, the apple slices began to oxidize and the brown color may have deterred students from wanting to taste the item. This was not an issue when preparing orange wedges. At Alice Deal School, it was noted that the apple slices even appeared partially frozen, which could have also deterred students from consuming them. Appearance and ease of consumption play a role in influencing children's eating habits. A majority of the students (90%) consumed the grape juice, as liquids are easier to consume with the rest of the meal during a short lunch period. Students were even observed sucking on the juice and leaving the pulp of the orange wedges. The orange wedges had an appealing taste, appearance, and were easy to consume, which could be why so many students consumed this sliced item as opposed to the sliced apple.

Behavioral economic strategies can promote fruit and vegetable consumption in students. Mathias et al. (2012) showed that by serving larger portions of fruits and vegetables without increasing total meal energy intake, children's consumption rate of fruits and vegetables increased. However, no effects were observed in children who did not like fruits and vegetables, and thus the author recommend combining increased fruit and vegetable portions with other behavioral economic strategies to promote healthy eating habits. Waite et al. (2012) found similar effects on milk consumption. When more skim milk was readily available and children had to ask for chocolate milk, consumption of skim milk increased. When fruits and vegetables

were paired with larger entrees in this study, we observed a decline in consumption of some of the fruits and vegetables that were paired with larger or more filling entrees. Decreasing the entrée size and increasing the fruit and vegetable portion could increase fruit and vegetable intake.

Behavioral economic research strategies and school health policies together can serve as a powerful method of nudging children to consume more healthy foods during the school day. Hanks et al. (2012) demonstrate the success of behavioral economic approaches utilizing the concept of libertarian paternalism. “Under libertarian paternalism, policies designed to influence choice do not infringe upon individual liberties, but instead rely on behavioral cues, such as changes to the environment, to gently nudge decision-makers.” (Hanks et al., 2012). By making simple, low-cost or even free changes to a school cafeteria environment, students can be encouraged to consume healthier foods. Hanks et al. (2012) organized a “lunchroom make-over” at a public high school by making changes such as hanging posters, using descriptive names to advertise food items, serving salads in transparent containers, displaying fruit in baskets, using colorful linens, introducing a shorter line where healthier options were served, placing healthier food in more accessible areas, and also nudging faculty members to provide verbal cues to promote children to choose healthy options. This low-cost revamp of the cafeteria required minimal time and effort on staff and resulted in increasing the chance that students consumed fruits from 40% to 47.7% and vegetables from 33.7% to 42%. This demonstrates that small, low-cost changes in the school environment can promote healthy behaviors.

Summary

This study provides some insight into the eating behaviors of middle school-aged children. Despite the fact that the nutrition standards of the school lunches in D.C. have

improved, it does not necessarily mean that students are benefiting from those changes. The challenge resides in offering foods that are both nutritious and appealing to students and promoting consumption through education and behavioral economic strategies. About half of the students consumed the fruits and vegetables offered in the school lunch. Students prefer to eat fruits over cooked or raw vegetables which could be due to having a greater familiarity with these items and because of their sweet taste. Students at Kelly Miller School consumed significantly more fruits than the students at Alice Deal School. It is possible that food insecurities outside of school, eating habits in the home, or school policies such as recess or health education could impact students' willingness to consume food items, in particular fruits and vegetables, offered as part of the school lunch. Behavioral economic strategies (or changes to recess policies) are a low cost method requiring minimal effort that can promote students to make healthy food choices during the school day. The pairing of food items should be considered when planning school lunch menus. The pairing of fruits and size of entrée may also influence students' consumption rates of the produce provided in the school meal. Although this study failed to show that sliced fruit was preferred over whole fruit, future studies may want to explore this in more detail using other types of fruits. Future studies including a more comprehensive study of the pairing of food items and behavioral economic interventions allowing children to still make choices may shed more light on the understanding of eating behaviors of middle school students.

CHAPTER 5

SUMMARY AND RECOMMENDATIONS

There are many confounding factors that are reported to contribute to childhood obesity. These include but are not limited to socioeconomic status, level of parental education, home environment, peers, access to healthy foods and play areas, physical activity levels, health knowledge and eating behaviors. This research project only investigated one small component of the obesity epidemic by exploring the effect of school health policy on students' consumption of school lunches after the new nutrient standards went into effect under the Healthy Schools Act. This study focused on student consumption of fruits and vegetables provided in the school lunches in two different D.C. public middle schools. There were three research questions addressed in this study:

1. What is the percentage of school lunch fruits and vegetables consumed by middle school students of Alice Deal School and Kelly Miller School?
2. Is there a significant difference in consumption patterns of fruits and vegetables between students of a Ward 3 and Ward 7 school, Alice Deal School and Kelly Miller School, respectively?
3. Is there a significant difference in consumption patterns of whole fruit and cut fruit among middle school students?

It was hypothesized that there would be no difference in the consumption patterns of fruits and vegetables between the students of a Ward 3 and Ward 7 school, Alice Deal School and Kelly Miller School, respectively. It was also hypothesized that there would be no significant difference in the consumption patterns of whole fruit and cut fruit among middle school students. This study indicates that only about half of the fruits and vegetables are

consumed from the school lunches. Additionally, students prefer fruits over cooked or raw vegetables. The students at Kelly Miller School consumed more food in general, but significantly more fruits than students at Alice Deal School. Pairing of items may influence students' consumption patterns in the fruits and vegetables. Presentation may also influence how much of an item a child will eat, as indicated by the apple intervention where more students preferred the whole apple versus the cut apple. Children's eating behaviors is a complex subject that needs to be explored more, as food policy changes alone do not automatically result in students consuming the items.

Recommendations for Future Studies

This study aimed to describe eating habits of middle school children in two schools in D.C. and investigate what, if any, differences in eating habits existed between students of different socioeconomic backgrounds. This project also attempted to understand how one intervention, serving a cut apple instead of a whole apple, could influence consumption patterns in middle school students. There are various portions of this study or factors related to this study that could be explored in future studies.

1. Future studies could explore this topic in more depth by observing any differences among gender and grade level. By the time many students reach high school, their eating habits have declined in that they have a tendency to choose foods high in sugar, sodium and fat. It would be interesting to see what factors influence these eating behaviors and when such factors are most prominent.
2. The difference between eating patterns between students of different socioeconomic status could be further explored. Although students from Kelly Miller School consumed more food in general than Alice Deal School students it would be

interesting to understand more about outside factors, such as parental education level and family support, and access to healthy foods and how these influence students' food choices in school.

3. Recent studies have correlated student academic performance with a healthy diet. Test scores and consumption of fruits and vegetables could be compared to see how this data set compares with other studies.
4. Surveying students about the foods they consume outside of school may also shed light on their eating patterns during the school day as well as their overall health.
5. Exploring future interventions using economic behavioral strategies to promote consumption of fruits and vegetables is necessary. This study only observed consumption patterns of an apple when it was provided to the students as a whole apple and when it was sliced. Alternative interventions such as preparation of produce and presentation of produce could influence students' food choices. Making simple changes to a school cafeteria such as hanging posters, presentation of fruits and vegetables, room lighting, linen colors have all shown to be successful methods that nudge kids to eat healthy foods.
6. Future studies could attempt to compare school lunch eating habits between students attending a high SES school and a low SES school that include all students not just those receiving free and reduced price lunch. This was a limitation from the present study that mostly compared students receiving free/reduced price lunch between schools.

Results from this study could be applied to future studies aiming at identifying and developing health intervention programs for students. Effective intervention programs need to consider a multi-faceted approach at multiple levels that include not only the students and school environment, but also parents/caregivers and the home environment. Health intervention programs can also be successful if approached from multiple levels and include all of the environments students are exposed to regularly (Looney and Raynor, 2012; Rosario et al., 2012; Condon et al., 2008; Power et al., 2008; Cullen et al., 2005; Birch and Davidson, 2001). Implementing school policies alone, for example, incorporation of more fruits and vegetables into school lunches is not enough to nudge kids to eat healthier. Rosario et al. (2012) showed that just by training teachers on nutrition education resulted in a significant higher consumption of fruits and vegetables in their students. The most effective strategies in nudging kids to consume more fruits and vegetables have involved changes in preparation methods, improvement in presentation of fruits and vegetables, incentive programs for kids, nutrition education, and tasting opportunities targeting fruit and vegetable consumption (Condon et al., 2009).

Conclusion

Childhood obesity has become an important topic of discussion after the alarming statistic that the prevalence of overweight and obese children has tripled in the last decade. As obese and overweight children are much more likely to develop into obese and overweight adults, it is important that we address the issue immediately. The obesity epidemic is very complex because so many variables contribute to the condition and each variable is different on the individual-level. However, developing healthy habits at a young age has shown to be promising in helping children develop into healthy adults. Understanding children's eating habits

and behaviors can play a crucial role in promoting healthy behaviors among young people. Because children spend so much time in school during the impressionable years of their life it makes sense to use schools as doorways to reach children and promote healthy behaviors. However, it is also important to consider all environments and influential factors that the students are exposed to when developing health programs for students. School health policy has an important role in initiating changes in school environments to promote healthier habits. However, much of the work needs to occur at the school-, family-, and student-levels to truly produce lifelong healthy behaviors.

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