RELATIONSHIP BETWEEN LUNCH TABLE TIME

AND STUDENTS' CONSUMPTION OF VITAMIN A,

VITAMIN C, CALCIUM, FIBER AND CALORIES

By

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Abstract: Advocacy groups recommend the length of the school lunch period be appropriate to allow students 20 minutes of table times, but there is limited scientific evidence to support the recommendation. The purpose of this study was to determine whether students who received more table time would consume more of the energy and select shortfall nutrients provided by the reimbursable school lunch. Table time was calculated by subtracting the time that the children exited the meal service line from the time that the children were dismissed from the table. A three-day plate waste study and nutrient analysis was conducted to identify food and nutrient consumption (i.e., total calories, vitamins A and C, fiber, and calcium). It was hypothesized that those students who had more table time would consume more nutrients. An independent sample t-test compared students' table time. Students who exited the meal service line first received significantly more table time (mean = 17.8, SD = 1.8) than those who exited the meal service line last (mean = 12.4, SD = 1.8, $p \leq 0.001$). A Pearson correlation analysis revealed positive correlation between table time and the amount of vitamin C and fiber consumed by students. A t-test was used to compare students with the longest table time to the National School Lunch Program nutrient standards for calories and each of the nutrients of interest. The analysis revealed the students with the most table time were not consuming enough food to meet the fiber, calcium or total calories standards for the school lunch program. Further research is needed to determine the amount of table time students need to meet the one-third RDA for shortfall nutrients and calories, and identify other factors that might be limiting food consumption in the school cafeteria.

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CHAPTER I

INTRODUCTION

Approximately one-third of American children are overweight or obese (Centers

for Disease Control and Prevention [CDC], 2013). There are both short-term and long-

term negative effects resulting from this epidemic. The effects have led to increased risks

and prevalence of cardiovascular disease including high cholesterol, and high blood

pressure (CDC, 2013). In addition, diseases such as type 2 diabetes, stroke, and cancer

are closely associated with overweight and obesity (CDC, 2013). In paradox to the

prevalence of obesity among America's youth, food insecurity is another issue. Food

insecurity may or may not result in hunger, but does result in disrupted eating patterns

with reduced food intake (USDA, 2013c). Several studies have shown a positive

correlation between food insecurity and overweight and obesity (Eisenmann, Gundersen,

Lohman, Garasky, Stewart, 2011). The Centers for Disease Control and Prevention

(CDC) has indicated that schools play a particularly important role for childhood health

habits because they establish a safe and supportive environment with policies for health

and wellness, as well as providing opportunities for children to learn and practice healthy

habits (CDC, 2013).

The National School Lunch Program (NSLP) serves approximately two-thirds of American children daily (ChildStat, 2013). For those students receiving free or reduced-price lunch, the NSLP can be the major source of good nutrition. Because of its important role in the nutrition of children, it is critical that meal pattern requirements stay consistent with the most current scientific evidence for supporting healthy weights and preventing hunger in children.

To meet these needs, Congress passed the Healthy, Hunger-Free Kids Act (HHFKA) of 2010. The HHFKA is focused on improving child nutrition by authorizing funding and enforcing policies for the types of foods that will be offered to children through various school-based nutrition programs (USDA, 2013a). The legislation was designed to address two specific aims including, 1) reducing the risk of obesity among school age children and 2) addressing the needs of students who are at risk for hunger/food insecurity (USDA, 2013b). The HHFKA is regulated through the United States Department of Agriculture (USDA) to assure school meals accurately reflect the most recent Dietary Guidelines for Americans.

Problem Statement

The regulations of the NSLP address, in detail, the meal pattern requirements (i.e., types and quantities of food being served) to assure the meals served meet the nutritional needs of school age youth (i.e., one-fourth of the RDA for breakfast and one-third of the RDA for lunch) (USDA, 2012a). One requirement that is rather vague is the amount of time scheduled in the school day for students to eat. The regulations state the schools should "provide sufficient lunch periods that are long enough to give all students

adequate time to be served and eat their lunches" (USDA, 2012a, pg 4148). Lunches must also be served between 10 a.m. and 2 p.m. (USDA, 2012a). Lack of consensus about optimum length of lunch creates a problem because if children are not given enough time to eat at a leisurely pace, they may over- or under-consume. The American Academy of Pediatrics (AAP) states that children should be able to consume their meal at a comfortable pace and recommends 20 minutes of table time (American Academy of Pediatrics, n.d.). While table time is not defined by the AAP, it is implied to be the amount of time children should have to consume their meal without the inclusion of hand-washing, standing in line, or discarding their trays after eating. More research is needed to understand the 20-minute table time recommendation and whether that is an adequate recommendation for students to consume enough food to take in one-third of the RDA provided by the school lunch meal.

Purpose of the Study

The purpose of the study was to evaluate the relationship between table time and consumption of the total calories and selected shortfall nutrients (i.e., calcium, vitamin A, vitamin C, and fiber). Fiber, calcium, vitamin A, vitamin C, and total calories were evaluated to determine whether there was an increased amount consumed when students received more time to eat. This study informs policy makers when establishing standard table time requirements. With a more thorough understanding of the problems, improvement can occur more readily to provide students with the optimum experience for school lunch consumption.

Assumptions

This study assumes that the food items were prepared according to the recipes and served in the quantities specified. Nutrient analysis was based on nutrient composition reports provided by the school, which are based on recipe and serving size guidelines. Additionally the study assumes that the days of observation were considered typical days for the elementary school. The researchers also assumed that the students did not eat differently in the presence of the research team, a phenomena known as the Hawthrone Effect (Zaleznik, 1984).

Limitations

Some limitations for consideration were observed, some of which were unanticipated. The children were offered several reimbursable entrée choices each day including a hot entrée, chef salad or sandwich. The salad option proved to be particularly hard to analyze using the picture method. The salads were served in in a plastic container and consisted of greens topped with cherry tomatoes, cheese, saltine crackers, and half of a hard-boiled egg. Many of the students who chose the salad ate only parts of it such as the tomatoes, cheese, or crackers. The provided dietary analysis was given for the whole salad, therefore making accurate measurement impossible for several students. Some salad entrees were included when consumption was based on all aspects of the salad.

There were also a few factors that may have limited the nutrient consumption and would be important for policy makers to be aware of when analyzing the lunch program. There was a high priority placed on controlling the noise level in the cafeteria wherein the cafeteria monitor used a reward system (i.e. candy) as a motivator. The students were

continually forced to turn their attention to announcements or demands throughout the lunch period (e.g., keep noise level down with the incentive of awarding candy). At any given lunch period, students received items such as suckers or tootsie rolls throughout the lunch period. It would have been beneficial to analyze how the intakes of children who received these items differed from students who did not. While recess before lunch has been considered a best practice, it may or may not have been considered a limitation for this study. It is unclear whether recess before lunch might prompt children to fill up quickly on milk and consume less food.

In addition, eligibility for free or reduced-price lunches was significantly lower than the national average. The school of interest had approximately 28% of the students eligible for free or reduced price lunch compared to 68.2% as the national average (USDA, 2013c).

<center>Abbreviations, Terms and Definitions</center>

CDC – Centers for Disease Control and Prevention

2010 Dietary Guidelines for Americans – Advice about calories, food choices, and physical activity to promote maintaining healthy weight and reducing the risk of chronic diseases.

Food insecurity – Disrupted eating including reduction in quality or variety of the diet (USDA, 2013c).

HHFKA – Healthy, Hunger-Free Kids Act

NSLP – National School Lunch Program

<center>5</center>

Overweight – A BMI at or above the 85th percentile and below the 95th percentile on the CDC growth charts for children of the same age and sex (CDC, 2013).

Obese – A BMI at or above the 95th percentile on the CDC growth charts for children of the same age and sex.

RDA – Recommended Dietary Allowances

Reimbursable meal – Refers to meals served under the federally reimbursed Child Nutrition Program. To qualify for reimbursement from the USDA the meal must contain specific food items in specific quantities (USDA, 2012c).

SBP – School Breakfast Program

USDA- United States Department of Agriculture

Very low food security – Disrupted eating patterns including reduced food intake (USDA, 2013c).

YRBSS – Youth Risk Behavior Surveillance System is a national school-based survey conducted by the CDC measures unhealthy dietary habits of youth among other health-risk behaviors (CDC, 2012).

CHAPTER II

REVIEW OF LITERATURE

Approximately one-third of American children are overweight or obese (Centers for Disease Control and Prevention [CDC], 2013). Short-term effects include increased risk factors for cardiovascular disease such as high cholesterol and high blood pressure, pre-diabetes, bone and join problems, sleep apnea, and social and psychological problems (CDC, 2013). Long-term effects include an increased prevalence of obesity through adulthood with health problems including heart disease, type 2 diabetes, stroke, various forms of cancer (i.e. breast, colon, esophagus, kidney, pancreas, gall bladder, thyroid, ovary, cervix, and prostate cancer), and osteoarthritis (CDC, 2013).

Several studies have shown a positive correlation between food insecurity and overweight and obesity (Eisenmann et al., 2011). In 2012, approximately 8.3 million children lived in food-insecure homes where both the parents and children were food-insecure (USDA, 2013a). In addition 977,000 children (about 1.3 percent of the nation's children) lived in households where at least one child lived with very low food security (USDA, 2013a).

The Centers for Disease Control and Prevention (CDC) has indicated that schools play a particularly important role for childhood health habits because they establish a safe and supportive environment with policies for health and wellness, as well as providing opportunities for children to learn and practice healthy habits (CDC, 2013).

National School Lunch Program

The National School Lunch Program (NSLP) has made a major impact on the diet for most children in the United States. In 2012, approximately 31.6 million students participated in the NSLP with about 68.2 percent of the students qualifying for either free or reduced price meals (USDA, 2013c). The NSLP serves approximately two-thirds of children between the ages of 6 and 17 years old daily (ChildStat, 2013).

Recently the regulations for the NSLP and School Breakfast Program (SBP) were revised to better meet the needs of the children and reflect the 2010 Dietary Guidelines for Americans. Some of the specific goals of the revisions were to reduce excess food and calorie intakes, make meal energy and nutrient contribution age appropriate, simplify menu planning, offer appealing foods to students, and monitor costs of meal preparation and menu items (Stallings, Suitor, & Taylor, n.d.). This was achieved by establishing calorie and nutrient targets for 3 age/grade groups including kindergarten through 5th grade, 6th through 8th grade, and 9th through 12th grade. The updated meal patterns include minimum amounts of vegetables, fruits, low-fat dairy, protein, and whole-grain rich breads, cereals, and pastas. The dietary specifications include minimum and maximum calorie levels, saturated fat, trans fat and sodium based on age group (USDA, 2012a). Nutrient targets increased from 8 to 24 targets (See Table 1).

Table 1: USDA (2012a) School Lunch and Breakfast Meal Patterns and Dietary Specifications

	Breakfast			Lunch		
	Grades K–5	Grades 6–8	Grades 9–12	Grades K–5	Grades 6–8	Grades 9–12
Meal Pattern	Amount of Foods[a] Per Week					
Fruits (cups)[b]	5	5	5	2.5	2.5	5
Vegetables (cups)[b]	0	0	0	3.75	3.75	5
Dark green	0	0	0	0.5[c]	0.5[c]	0.5[c]
Orange	0	0	0	0.5[c]	0.5[c]	0.5[c]
Legumes	0	0	0	0.5[c]	0.5[c]	0.5[c]
Starchy	0	0	0	1	1	1
Other	0	0	0	1.25[c]	1.25[c]	2.5[c]
Grains, at least half of which must be whole grain-rich[d] (oz eq)	7–10	8–10	9–10	9–10	9–10	12–13
Meats, beans, cheese, yogurt (oz eq)	5	5	7–10	8–10	9–10	10–12
Fat-free milk (plain or flavored) or low-fat milk (1% milk fat or less) (cups)	5	5	5	5	5	5
Other Specifications	Other Specifications: Daily Amount Based on the Average for a 5-Day Week					
Min-max calories (kcal)[e,f]	350–500	400–550	450–600	550–650	600–700	750–850
Saturated fat (% of total calories)[g]	< 10	< 10	< 10	< 10	< 10	< 10
Sodium (mg)	[≤ 430]	[≤ 470]	[≤ 500]	[≤ 640]	[≤ 710]	[≤ 740]
	Sodium targets are to be reached by the year 2020.[h]					
trans fat	Nutrition label must specify zero grams of *trans* fat per serving.[i]					

NOTES: K = kindergarten; kcal = calories; max = maximum; mg = milligrams; min = minimum; oz eq = ounce equivalent. Although the recommended weekly meal intake patterns do not specify amounts of unsaturated oils, their use is to be encouraged within calorie limits.

[a]Food items included in each group and subgroup and amount equivalents. Appendix Table H-1 gives a listing of foods by food group and subgroup. Minimum daily requirements apply: $\frac{1}{5}$ of the weekly requirement for fruits, total vegetables, and milk and at least 1oz equivalent each of grains and meat or meat alternate (2 oz of each for grades 9–12 lunch).

[b]One cup of fruits and vegetables usually provides two servings; ¼ cup of dried fruit counts as ½ cup of fruit; 1 cup of leafy greens counts as ½ cup of vegetables. No more than half of the fruit offerings may be in the form of juice.

[c]Larger amounts of these vegetables may be served.

[d]Based on at least half of the grain content as whole grain. Aiming for a higher proportion of whole grain-rich foods is encouraged. See Box 7-1 for Temporary Criterion for Whole-Grain Rich Foods. Also note that in Chapter 10 the committee recommends that the Food Buying Guide serving sizes be updated to be consistent with MyPyramid Equivalent serving sizes.

[e]The average daily amount for a 5-day school week is not to be less than the minimum or exceed the maximum.

[f]Discretionary sources of calories (for example, solid fats and added sugars) may be added to the meal pattern if within the specifications for calories, saturated fat, *trans* fat, and sodium.

[g]The average daily amount for a 5-day school week is not to exceed the maximum.

[h]To ensure that action is taken to reduce the sodium content of school meals over the 10-year period in a manner that maintains student participation rates, the committee suggests the setting of intermediate targets for each 2-year interval. (See the section "Achieving Long-Term Goals" in Chapter 10.)

[i]Because the nutrition facts panel is not required for foods with Child Nutrition labeling, the committee suggests that only products with 0 grams of *trans* fat per serving be eligible for consideration for such labeling.

Shortfall Nutrients and Nutrients of Concern

The Report of the Dietary Guidelines Advisory Committee on the Dietary Guidelines for Americans, 2010, identifies vitamins A, C, D, K, magnesium, potassium, calcium and fiber as shortfall nutrients (USDA, 2010a). The 2010 Dietary Guidelines further identifies calcium, vitamin D, fiber and potassium as nutrients of concern. These nutrients in particular were linked to indicators of nutrient inadequacy and disease prevalence (USDA, 2010b). Calories are also of concern when addressing dietary adequacy because they are frequently over- or under-consumed, thus playing a critical role in healthy weight maintenance. The scope of this literature review is to address in depth vitamins A and C, calcium, fiber and calories.

Vitamin A and Vitamin C

Previous to the revision of the regulations in 2012, vitamins A and C were included in the nutrient analysis of school meals and many schools are continuing to include these items in their nutrient analyses.

Vitamin A is essential for vision, maintaining healthy bone, teeth, soft tissue, cell membranes and skin (National Institutes of Health [NIH], 2011). Vitamin C is important in the function of growth and repair of tissues, wound healing, iron absorption and acts as an antioxidant (NIH, 2011). To meet the current RDA for vitamin A and vitamin C, the Recommended Dietary Allowance for moderately active school age youth is 1 to 1 ½ cups of fruit and 1 ½ to 2 ½ cups of vegetable everyday (USDA, 2010a). The Youth Risk Behavior Surveillance indicates that only 22.4 percent of high-school age youth had fruit

or 100% fruit juice three or more times per day, and only 15.3 percent had eaten vegetables three or more times per day (CDC, 2012).

To address the gap in consumption versus recommendation, the revised USDA lunch meal pattern requires students be offered a minimum of ½ cup fruit per day and ¾ cup vegetables per day (USDA, 2013a). The daily recommendation for vitamin A in children ages 4 to 8 years is 400 mcg of Retinoic Acid Equivalents (RE) and for children ages 9-13 it is 600 mcg of RE or about 2,000 IUs (USDA, 2013d). Good sources that would be particularly important in a school age children's diets include fortified milk, eggs, green leafy vegetables, orange and yellow vegetables, tomato products, and fortified cereals. The recommendation for vitamin C for children ages 4 to 8 years is 25 mg/day, while the recommendation for children 9 to 13 years is 45 mg/day. Good sources of vitamin C include fruits, especially citrus fruits, and vegetables. As such, the increased number of fruits and vegetables required in the new guidelines for the NSLP should better address the shortfall of these nutrients unless an external factor influences the children's consumption such as inadequate time to consume sufficient food.

Fiber

Fiber is an essential component of food that is identified by the Dietary Guidelines for Americans 2010 as a nutrient of concern (USDA, 2010a). Inadequate fiber intake can manifest in uncomfortable symptoms in school age children including constipation and abdominal pain, and can be easily treated, in most cases, with adequate fiber intake (Paulo, Amancio & de Morais, 2006). In addition to possible gastrointestinal (GI) benefits, some data suggest that benefits of adequate fiber intake include

maintenance of healthy body weight and reduced risk of type 2 diabetes (Paulo et al., 2006). Sources of fiber include whole-grain breads and cereals, fruits and vegetables, and nuts and seeds (USDA, 2010b). While an official RDA has not been set for fiber, adequate intake recommendations are 25 to 31 g for elementary age students (National Research Council, 2005). This would require students receive approximately 8.3 g of fiber from the school lunch. The USDA did not define a specific amount of fiber to be served in each meal, however, the regulations state increased fiber as a goal in menu planning (USDA, 2012a). Achievement of this goal is addressed by requiring increased quantities of fruits, vegetables and whole grain rich foods, which are excellent sources of fiber.

Vitamin D and Calcium

Vitamin D, one of the four nutrients of concern is negatively associated with adiposity (Kumar et al., 2009, Gilbert-Diamond et al., 2010). It is also essential for active intestinal calcium and phosphate absorption (USDA, 2010a). As such, calcium and vitamin D perform synergistically in bone formation and maintenance.

The mineral calcium is also included as a nutrient of concern by the Dietary Guidelines for Americans (USDA, 2010a). Calcium is critical for bone development, muscle contraction, coagulation of blood, nerve impulses, activation of enzyme reactions, and hormone secretions (USDA, 2010a). Excellent sources of calcium include milk, cheese, and yogurt (USDA, 2010a). Because milk is a strong source of calcium and vitamin D, fluid milk is a required component of the reimbursable meal through the

NSLP (USDA, 2012a). The requirement accounts for about one-third RDA (i.e., 433mg of calcium per day) (USDA, 2012a).

Calorie Ranges

In addition to setting new standards for fruit and vegetable intake, the 2012 NSLP revised regulations set minimum and maximum calorie ranges for grade groups (USDA, 2012a). The groups were established to help provide age appropriate school meals (USDA, 2012a). Advocates for the revised regulations indicated that setting a minimum and maximum calorie limit would help overcome the food insecurity and obesity epidemic in America (USDA, 2012a). The USDA recognizes the role that the school meal programs play in providing nutrition safety for food-insecure children and that providing adequate calories for growth and development is crucial (USDA, 2012a). The grade groups included kindergarten through 5th grade at 550-650 calories per week. For students in grades 6th through 8th calorie ranges from 600 to 700 and for high school students grades 9th through 12th calorie ranges from 750 to 850.

Meeting the recommendations for the shortfall nutrients can be achieved by following the dietary guidelines. In contrast, many Americans are not meeting these recommendations (USDA, 2010b). Having adequate time to eat school meals can help school age youth achieve dietary recommendations (Conklin, Lambert & Anderson, 2002).

Time Recommendations for School Lunch Periods

Allowing children adequate time to eat at a comfortable pace is one factor affecting the nutrition of children (Conklin et al., 2002). Several studies have investigated

the amount of time allotted to children to eat school lunch and the overall effect on their food intake. In 2000, the USDA and five medical groups worked together to address some of the issues related to childhood obesity. Together they formed the Partnership to Promote Healthy Eating in Schools and developed *Prescription for Change: Ten Keys to Promote Healthy Eating in Schools,* which outlined strategies to help improve students' diet and health through school interventions.

One of the ten keys addressed the amount of time for lunch stating "all students will have designated lunch periods of sufficient length to enjoy eating healthy foods with friends. These lunch periods will be scheduled as near the middle of the school day as possible" (USDA, 2000). This was important because it created awareness that the length of the lunch period was important as it helped create a nutritionally supportive environment to provide students with the skills and opportunities to develop healthy eating habits.

In 2000 the School Health Policies and Programs Study conducted by the CDC indicated that 19.7 percent of schools gave students less than 20 minutes to eat their lunch once they are seated (CDC, 2000). More recent data from the School Nutrition Dietary Analysis-III (SNDA-III), reflects the average length of the lunch period in 98 reporting elementary schools was approximately 31 minutes (USDA, 2007). This amount of time includes moving from the classroom to the cafeteria, washing hands, standing in line, eating the meal, and socializing with friends. Although 31 minutes was found to be the average among these schools, there are approximately 98,000 schools participating in the NSLP and therefore it cannot be assumed that this is a national average (USDA, 2013b).

Neither of the studies looked at the relation between the length of the lunch period and students' consumption of the meal.

To better define a "lunch period of sufficient length" Conklin et al. (2002) conducted an analysis of three studies assessing different components of the question. The first study titled, *Measuring and Evaluating the Adequacy of the School Lunch Period* conducted by Sanchez, Hoover, Cater, Sanchez, and Miller (1999) addressed the school lunch period. The purpose of the study was to determine the amount of time spent by children to receive, consume and discard their lunch. They looked at three aspects including 1) the speed of service, 2) the time at the table, and 3) busing of dishes. The researchers then broke down the time even further to analyze time spent waiting in line, waiting for the cashier, travel to the eating area, and eating time and non-eating time at the table. The second and third studies analyzed by Conklin et al., (2002) were both conducted by Bergman, Buergel, Joseph and Sanchez (1999; 2000) and analyzed the amount of time children were given to eat after waiting in line and how much of that time they actually spent consuming their food.

From these studies, Conklin et al. (2002) suggested that it took students an average of 7 to 10 minutes to physically eat their lunch; however, one study reported that 39% of elementary children took a longer amount of time. The time needed did not account for time spent socializing, preparing foods, using condiments, or other non-eating behaviors. Elementary children may take especially long in this area when dealing with things such as opening condiment packets, milk cartons and other preparation techniques. The time spent engaging in non-eating behaviors can be almost as important as the act of eating itself (Conklin et al., 2002). The socializing allows children the opportunity to

interact with peers and gives them a break in routine so that they can return to class refreshed and ready to continue learning (Conklin et al., 2002). As such, Conklin et al. (2002) concluded that about 20 minutes is needed for children to eat. Therefore, additional time should be added to the lunch period to allow the students to go through the line and travel to the cafeteria. Conklin et al. suggests that 26 minutes should be a minimum for cafeteria time with 4 minutes of travel time to total a complete 30-minute lunch period. This is consistent with the findings from the SNDA-IV (USDA, 2012b) analysis stating that the average lunch period was 31 minutes.

A third study conducted by Bergman, Buergel, Femrite and Englund (2004) and not included in Conklin's analysis, compared the relationship between the total length of the school lunch period and the amount of nutrients consumed among elementary children. A plate waste method was used to determine if students in one school who received a 30-minute lunch period consumed significantly more nutrients than those in a second school who received only 20 minutes. Results of the study indicated that food waste decreased substantially when the length of the lunch period was 30 versus 20 minutes (Bergman et al., 2004). The longer lunch period was associated with increased consumption in most vitamins and minerals by study participants. "Providing a longer lunch period may provide the time necessary to encourage students to eat more of the foods most often neglected, such as fruits, vegetables, and milk" (Bergman et al., 2004). This is especially worth exploring because the school lunch program is designed to provide one-third of the RDA for nutrients. Therefore, if the children are not eating the majority of food that they are served, they may develop a chronic deficit of nutrients required for optimum growth.

In summary, the NSLP provides students with approximately one-third of the RDA for calories and nutrients needed for healthy growth and development (USDA, 2013a). However, because of the increased pressure in meeting academic standards, school focus has not been aimed at the nutritional needs of the children (United States Department of Education, n.d.). This is of concern in that students may not have adequate time to consume a healthy meal and may be limiting their consumption of foods rich in nutrients frequently lacking in their diet. A limited amount of research has been conducted to determine the amount of table time students have to eat lunch. No studies have been conducted reviewing the relationship between table time and specific shortfall nutrients and calories.

CHAPTER III

METHODS

The primary purpose of the study was to evaluate the amount of table time in relation to elementary school age students' consumption of the total calories, calcium, vitamin A, vitamin C, and fiber. The second, third, and fourth grade students at an elementary school in Edmond, Oklahoma were the test subjects for this project. The plate waste study was conducted on May 6 through 8, 2013. The school was chosen due to their interest in the study question. At the time of the study the school had an enrollment of approximately 919 students pre-kindergarten through 5th grade. Racial make-up of the school was 55% Caucasian, 15% African American, and the remaining 30% were of other ethnicities (Great Schools, n.d.). The racial distribution is similar to that seen in the general population (USDA, 2008). Approximately 28% of the students were eligible for free or reduced price lunch compared to a national average of 68.2% (USDA, 2013c).

The study was approved by the Oklahoma State University Institutional Review Board. Parents of students were informed of the study protocol and purpose through the school website and informational flyers sent home in student folders. Student assent was obtained by the researchers asking students if a picture of their tray could be taken.

Parents who did not want their child to participate were instructed to inform their children to respond no when asked if a picture of the tray could be taken. If the student responded no, the researcher thanked the child and he/she was bypassed. IRB approval documentation and supporting forms are in Appendix A.

The school study site had 2 identical food service lines serving the same items. The lunch period was separated by grades, and each grade was further separated into 2 groups, which entered and exited the lunchroom 5 minutes apart. Students entered the cafeteria by group after a mid-day recess and entered one of the two meal service lines. The total length of the scheduled lunch period for each grade (i.e., both groups within each grade) was 25 minutes.

<div align="center">Plate Waste Study</div>

Visual plate waste study methods developed by Comstock, Pierre, & Macklernan (1981) were used to calculate the amount of food consumed by the students. These methods included using a digital camera to take a series of two pictures for each meal. The first recorded the foods selected by the students upon leaving the meal service line and the second recorded the amount of food left on the tray at the end of the meal service period (See Figure 1).

Figure 1: Example Photographs of Pre- and Post Consumption

Pre   Post

The selected observations included the first and last five students of each group

in the meal service line who received a reimbursable lunch meal. Trained research

assistants asked students as they exited the meal service line if a digital photograph could

be made of the meal tray. If the student agreed then a numbered card was placed on the

tray and a picture of only the tray was taken. The numbered card served as an identifier to

match the pre- and post meal observations. No identifying parts of the child were

included in the picture, nor was the child's name associated with the picture. The student

then proceeded to eat as normal. Upon dismissal, the students with numbered cards were

asked to place their trays on the stage area (this was to avoid disrupting the time of the

meal service period). To calculate the amount of milk consumed, the remaining milk was

weighed using a calibrated digital scale (Ohas Scales, CS Series, CS500-001) and

recorded on the numbered cards, then the card was placed back on the tray before a

second picture was taken Daily menu items along with their nutrient composition of each

selected shortfall nutrients and total calories per serving are shown in Table 2.

Table 2: Menu Items Served and Analyzed for Consumption

Item	Vitamin A (IU)	Vitamin C (mg)	Fiber (g)	Calcium (mg)	Calories (kcal)
Day 1					
Spaghetti w/ Meat sauce	801	12.99	1.09	56.4	301
Cheesy garlic breadstick	62	0	1.07	33.1	96
Zucchini	202	18.04	1.01	16.2	38
Side Caesar salad	2000	1	0.75	65.8	59
Pineapple	0	4.65	0.78	15.5	62
Day 2					
BBQ Chicken Sandwich	444	5.33	1	106	245
Sweet Potato Fries	2859	3.43	2.86	0	143
Corn	92	4.54	1.7	2.9	65
Grapes	75	12.17	0.75	15	78
Day 3					
Nachos w/ Gr. Turkey	280	0.41	1.43	203	288
Refried Beans	152	7.93	5.58	103.8	133
Apple Slices	37	3.17	1.66	4.1	36
*Milk	500	1.2	0	300	116
*Salad Entrée	6556	14.04	4.02	117.1	434
*Ham Sandwich	19	1.06	4.0	356.5	227

*These items were offered each day.

To calculate the amount of food eaten, the pre- and post pictures for each numbered tray were compared. Each food item on the tray was analyzed for the proportion eaten (i.e., all, three-fourths of the item eaten, one-half of the item eaten, one-fourth of the item eaten, none of the item eaten). Quantity of milk consumed was calculated by determining how many fluid ounces each child drank. First, the full carton of chocolate milk, regular milk, and vanilla milk were weighed individually. The weight of an empty carton was also weighed for each milk type. The weight of milk contained within each container was determined by subtracting the weight of an empty carton from a full carton (i.e., 9.2 ounces chocolate milk carton – 0.5 ounces empty chocolate milk carton = 8.7 ounces of milk per container). The same procedure was followed for each

carton after the student finished with the meal. The percentage of milk consumed was calculated and used for nutrient analysis.

To analyze the nutrients consumed during the lunch period, nutrient analysis for each menu item was provided by the school district including information on fiber, calcium, vitamin A, vitamin C, and calories. The amount consumed of each item (i.e., all, ¾, ½, ¼, or none) was multiplied by the nutrient contribution of one serving for each nutrient of interest. Totals were recorded in the Excel spreadsheet.

Determination of Table Time

To calculate table time the camera used to take meal pictures provided a time stamp recording the time the students left the meal service line. Because children were dismissed at the same time, one time was recorded for dismissal. Table time was calculated by subtracting the camera time stamp from the dismissal time signaling the end of the lunch period. Table time from each plate waste observation was recorded.

Statistical Analyses

Statistical analyses were conducted using SPSS software version 22.0 (Chicago, IL). An independent sample t-tests was used to compare table time for the students receiving the most table time compared to the students receiving the least table time. Frequency analysis was used to describe the percentage of students eating different amounts of each food items served over the three-day study period. Pearson product-moment correlation analysis was used to examine the relationship between table time and consumption of each nutrient.

Level of significance for all tests was set at $p < 0.05$.

CHAPTER IV

RELATIONSHIP BETWEEN LUNCH TABLE TIME AND STUDENTS' CONSUMPTION OF
CALORIES, VITAMIN A, VITAMIN C, CALCIUM AND FIBER FROM THE
REIMBURSABLE MEAL

INTRODUCTION

BACKGROUND

The childhood obesity epidemic in America includes both short-term and long-term effects including increased risk for diseases such as cardiovascular disease, high blood pressure, high cholesterol, bone and joint problems, pre-diabetes, and cancer (CDC, 2013). Several studies have shown a positive correlation between food insecurity and overweight and obesity (Eisenmann et al., 2011). Food insecurity among America's youth is problematic with approximately 8.3 million children in 2012 living in homes where both the parents and children experienced food insecurity (USDA, 2013a). Another 977,000 children (about 1.3% of the nation's children) lived in households where at least one child experienced very low food security (USDA, 2013a).

The Centers for Disease Control and Prevention (CDC) has indicated that schools play a particularly important role for childhood health habits because they establish a safe and supportive environment with policies for health and wellness, as well as providing

opportunities for children to learn and practice healthy habits (CDC, 2013). In 2012,

approximately 31.6 million students participated in the National School Lunch Program

(NSLP) and approximately 12 million in the School Breakfast Program (SBP) with about

68.2% of the students qualifying for either free or reduced price meals. There are

approximately 49.6 million school-age children in the United States ages 6 to 17 years,

meaning that the NSLP serves over two-thirds of children daily (ChildStats, 2013).

In response to the growing problems in childhood nutrition, the Healthy, Hunger-

Free Kids Act (HHFKA) was passed by Congress in 2010. The purpose of the law is to

improve child nutrition by authorizing funding and enforcing policies for the types of

foods that will be offered to children through various USDA programs (USDA, 2013a).

The legislation was designed in order to address two specific aims including; 1) reducing

the risk of obesity among school age children and 2) addressing the needs of students

who are at risk for food/food security. To assure implementation of the law the USDA

revised regulations for the NSLP and SBP. Calorie and nutrient targets were established

for 3 age/grade groups including kindergarten through fifth grade, sixth through eighth

grade, and ninth through twelfth grade. Minimum amounts of vegetables, fruits and

whole-grain rich foods were increased, minimum and maximum calorie levels were

established and dietary specifications were set for saturated fat, trans fat, and sodium

(USDA, 2012a). Nutrient targets increased from 8 to 24 targets.

SHORTFALL NUTRIENTS AND NUTRIENTS OF CONCERN

The Report of the Dietary Guidelines Advisory Committee on the Dietary

Guidelines for Americans, 2010, identifies vitamins A, C, D, calcium and fiber as

shortfall nutrients (USDA, 2010a). Updates to the school meal patterns help to insure that school age children are being offered foods that provide the nutrients most lacking in children's diets. This is being achieved by an increase in servings of fruits and vegetables, addition of whole-grains and the requirement for vitamin D fortified milk. By following these recommendations, adequate amounts of vitamin A, C, fiber and calcium should be met unless an external factor influences the children's consumption such as inadequate time to consume sufficient food.

In addition to acknowledging the need for increased quantities of fruits and vegetables, USDA recognized the role that the school meal programs play in providing nutrition for food-insecure children and that providing adequate calories for growth and development is crucial (USDA, 2012a). Advocates for the revised regulations indicated that establishing a calorie range would help overcome the food insecurity and obesity epidemic in America (USDA, 2012a). This is based on the knowledge that children who are living in food insecure homes, where intake is not meeting nutrient needs, are needing adequate nutrition at school (Eisenmann et al., 2011). As such, calorie ranges were established for kindergarten through 5th grade at 550 to 650 calories per day, 6th through 8th grade at 600 to 700 calories per day and 9th through 12th grade at 750 to 850 calories per day. The age groups were established to help provide age appropriate school meals (USDA, 2012a).

TIME RECOMMENDATION FOR SCHOOL LUNCH PERIODS

One question that does not get much attention is the amount of time that children are given to eat. New USDA regulations state that schools should "provide sufficient

lunch periods that are long enough to give all students adequate time to be served and eat their lunches" (USDA, 2012). The American Academy of Pediatrics states that children should be able to consume their meals at a comfortable pace and recommends 20 minutes of table time (American Academy of Pediatrics, n.d.). While table time is not defined by the CDC, it is implied to be the amount of time children should have to consume their meal without the inclusion of hand-washing, standing in line, or discarding their trays after eating.

There are few studies examining the relationship between table time and nutrient consumption. One study conducted by Sanchez and associates (1999) looked at three aspects including; 1) the speed of service, 2) the time at the table, and 3) busing of dishes. The researchers then broke down the time spent waiting in line, waiting for the cashier, travel to the eating area, and eating time and non-eating time at the table. It was found that an average of 4 minutes, 15 seconds was spent waiting in line, 8 minutes, 30 seconds spent eating, 14 minutes 27 seconds engaging in non-eating behaviors at the table, and 36.5 seconds busing their dishes. Two more studies conducted by Bergman and associates (1999, 2000) also analyzed the amount of time children were given to eat after waiting in line and how much of that time they actually spent consuming their food. Similar results were shown as those conducted by Sanchez et al. with a recommended average of 7 to 12 minutes allotted for meal consumption. It was recommended that 22 minutes be allotted for table time to include both eating and non-eating behaviors.

In a review of the three studies by Conklin and associates (2002), it is suggested that it takes students an average of 7 to 10 minutes to physically eat their lunch, not including the time spent socializing, preparing foods, using condiments, or other non-

eating behaviors. It was concluded that about 20 minutes is needed for children to eat and that a lunch period of 26 minutes should be a minimum for cafeteria time with 4 minutes travel for a total of 30 minute lunch period.

Another study was conducted by Bergman and associates (2004) compared the relationship between the total length of the school lunch period and the nutrients consumed among elementary children. Plate waste was analyzed to determine if students in one school who received a 30-minute lunch period consumed significantly more nutrients than those in a second school who received only 20 minutes. The study concluded that the longer lunch period led to increased consumption overall in most vitamins and minerals. More research is needed in this area to understand the 20-minute lunch period recommendation and whether that is an adequate recommendation for total lunch period or if it should be modified.

The purpose of the current study was to evaluate the relationship between table time and consumption of the total calories and selected shortfall nutrients (i.e., calcium, vitamin A, vitamin C, and fiber). Fiber, calcium, vitamin A, vitamin C, and total calories were evaluated to determine whether there was an increased amount consumed when students received more time to eat. This study provides information for policy makers to better understand barriers to students' meal consumption. With a more thorough understanding of the problems, improvement can occur more readily to provide students with optimum experience for school lunch consumption.

METHODS

The primary purpose of the study was to evaluate the amount of table time in relation to elementary school age students' consumption of the total calories, calcium, vitamin A, vitamin C, and fiber. The study was conducted in an urban Oklahoma elementary school. The school had two identical serving lines. Each grade had its own lunch period. Half of the grade group entered the lunchroom first and entered filed into both serving lines. Five minutes later, the other half of the grade group entered the lunchroom, and again entered either of the serving lines. The researchers then took pictures of the first five students to exit the lunch line of each group and the last five students in each line for each group.

The plate waste and table time was conducted on second, third and fourth grade students and observation took place May 2013 with 3 observation days dedicated to plate waste analysis, and 5 days dedicated to table time observations. The school was chosen due to their interest in the study question. At the time of the study, the school had an enrollment of approximately 919 total students, which included pre-kindergarten through 5th grade. Racial make-up of the school was 55% Caucasian, 15% African American, and the remaining other ethnicities (Great Schools, n.d.). Approximately 28% of the students were eligible for free or reduced price lunch compared to a national average of 68.2% (USDA, 2013c).

The study was approved by the Oklahoma State University Institutional Review Board. Parents of students were informed of the study protocol and purpose through the school website and informational flyers sent home in student folders. Students assent was

obtained by the researchers asking students if a picture of their tray could be taken. Parents who did not wish for their child to participate were instructed to inform their children to respond either "yes" or "no" when asked if a picture of the tray could be taken. If the student responded "no", the researcher thanked the child and he/she was bypassed.

The school study site had 2 identical food service lines serving the same items. The lunch period was separated by grades, and each grade was further separated into 2 groups, which entered and exited the lunchroom 5 minutes apart. Students entered the cafeteria by group after a mid-day recess and entered one of the two meal service lines. The total length of the scheduled lunch period for each grade (i.e., both groups within each grade) was 30 minutes.

PLATE WASTE STUDY

Visual plate waste study methods developed by Comstock, Pierre, & Macklernan (1981) were used to calculate the amount of food consumed by the students. These methods included using a digital camera to take a series of two pictures for each meal. The first recorded the foods selected by the students upon leaving the meal service line and the second recorded the amount of food left on the tray at the end of the meal service period. The selected observations included the first and last five students of each group in the meal service line who received a reimbursable lunch meal. Trained research assistants asked students as they exited the meal service line if a digital photograph was made of the meal tray. If the student agreed then a numbered card was placed on the tray and a picture of the tray was taken. The numbered card served as an identifier to match the pre- and

post meal observations. No identifying parts of the child were included in the picture, nor was the child's name associated with the picture. The student then proceeded to eat as normal. Upon dismissal, the students with numbered cards were asked to place their trays on the stage area (this was to avoid disrupting the time of the meal service period). Milk consumption was directly measured. To calculate the amount of milk consumed, the remaining milk was weighed using a calibrated digital scale (Ohas Scales, CS Series, CS500-001) and recorded on the numbered cards, then the card was placed back on the tray before a second picture was taken. Daily menu items along with their nutrient contribution of each selected shortfall nutrient and total calories per serving are shown in Table 2.

Table 2: Menu Items Served and Analyzed for Consumption

Item	Vitamin A (IU)	Vitamin C (mg)	Fiber (g)	Calcium (mg)	Calories (kcal)
Day 1					
Spaghetti w/ Meat sauce	801	12.99	1.09	56.4	301
Cheesy garlic breadstick	62	0	1.07	33.1	96
Zucchini	202	18.04	1.01	16.2	38
Side Caesar salad	2000	1	0.75	65.8	59
Pineapple	0	4.65	0.78	15.5	62
Day 2					
BBQ Chicken Sandwich	444	5.33	1	106	245
Sweet Potato Fries	2859	3.43	2.86	0	143
Corn	92	4.54	1.7	2.9	65
Grapes	75	12.17	0.75	15	78
Day 3					
Nachos w/ Gr. Turkey	280	0.41	1.43	203	288
Refried Beans	152	7.93	5.58	103.8	133
Apple Slices	37	3.17	1.66	4.1	36
*Milk	500	1.2	0	300	116
*Salad Entrée	6556	14.04	4.02	117.1	434
*Ham Sandwich	19	1.06	4.0	356.5	227

*These items were offered each day.

To calculate the amount of food eaten, the pre- and post pictures for each numbered tray were compared. The proportion of food item eaten (i.e., all, three-fourths of the item eaten, one-half of the item eaten, one-fourth of the item eaten, none of the item eaten) was estimated. Quantity of milk consumed was calculated by determining how many fluid ounces each child drank. First, the full carton of chocolate milk, regular milk, and vanilla milk were weighed individually. The weight of an empty carton was also weighed for each milk type. The weight of milk contained within each container was determined by subtracting the weight of an empty carton from a full carton (i.e., 9.2 ounces chocolate milk carton – 0.5 ounces empty chocolate milk carton = 8.7 ounces of milk per container). The same procedure was followed for each carton after the student finished with the meal. The percentage of milk consumed was calculated and used for nutrient analysis.

To calculate the nutrients consumed during the lunch period, nutrient contents for each menu item was provided by the school district including information on fiber, calcium, vitamin A, vitamin C, and calories. The estimated amount consumed of each item (i.e., all, three-fourths, one-half, one-fourth, or non) was multiplied by the nutrient contribution for each nutrient of interest. Totals were recorded for statistical analysis.

DETERMINATION OF TABLE TIME

To calculate table time, the camera used to take meal pictures provided a time stamp recording the time the students left the meal service line. Because children were dismissed at the same time, one time was recorded for dismissal. Table time was

calculated by subtracting the camera time stamp from the dismissal time signaling the end of the lunch period. Table time from each plate waste observation was recorded.

STATISTICAL ANALYSES

Statistical analyses were conducted using SPSS software version 22.0 (Chicago, IL). An independent sample t-test was used to compare table time for students receiving the most table time compared to students receiving the least table time. Pearson product-moment correlation analysis was used to examine the relationship between table time and consumption of each nutrient. Frequency analysis was used to characterize the percentage of students eating different amounts of each food item served over the three-day study period.

Level of significance for all tests was set at $p < 0.05$.

RESULTS

TABLE TIME

Students who exited the lunch line first received significantly more time to eat than those who exited last ($p \leq 0.001$). On average the students who exited first received approximately 5 and a half more minutes of table time (17.8 minutes versus 12.4 minutes, respectively). Even the students with the most amount of table time were not receiving 20 minutes for meal consumption. The findings in relation to table time are presented in Table 3.

Table 3: Comparison of Table Time for Students With the Most and Least Time to Eat.

Study Groups	Mean	SD	p value
Most (n=154)	17.8 minutes	±1.8	$\leq 0.001^a$
Least (n=152)	12.4 minutes	±1.8	

^{a}*Statistical significance set at* $p < 0.05$

PLATE WASTE

Table 4 summarizes the proportion of food items eaten by students during the three-day plate waste study. On each day, the menu items least consumed (i.e., none eaten) were the vegetables. The table also displays that many of the menu items were consumed in higher amounts among the students who exited the lunch line first.

Table 4: Percentage of Meal Consumed; Most versus Least Table Time (N=306)

	All (First/Last)	75% (First/Last)	50% (First/Last)	25% (First/Last)	None (First/Last)
Spaghetti	57/55	6/15	10/7	10/5	17/17
Caesar Salad	27/25	0/2	8/9	2/2	63/62
Zucchini	4/6	2/0	0/0	6/2	88/92
Pineapple	45/42	6/13	10/8	4/8	35/29
Breadstick	17/62	10/0	4/7	0/4	69/27
BBQ Sandwich	56/26	4/10	12/16	6/7	22/41
Corn	31/65	7/2	11/12	2/8	49/13
Sweet Potato Fries	9/6	2/2	2/2	7/0	80/90
Grapes	65/20	5/6	11/22	5/8	15/44
Nachos	49/31	20/27	18/26	13/4	0/3
Beans	56/11	12/0	7/2	5/14	20/85
Apples	47/29	17/10	5/10	7/10	24/41
Salad Entrée	14/13	14/7	14/27	29/20	29/33
Sandwich	100/44	0/17	0/22	0/0	0/17

Table 5 summarizes the correlation between table time and nutrient consumption for vitamin A, vitamin C, fiber, calcium and total calories. Consumption of each nutrient was correlated with table time. It was found that as table time increased it significantly increased consumption of vitamin C and fiber. No significant correlation was shown with vitamin A, calcium or total calorie consumption.

Table 5: Correlations Between Table Time and Intake of Vitamin A, Vitamin C, Fiber, Calcium and Calories

	Vitamin A	Vitamin C	Fiber	Calcium	Calories
Table Time (N=306)	0.04	0.16^{a}	0.12^{b}	-0.04	0.07

$^{a}p = 0.006, {}^{b}p = 0.036$

RDA COMPARISONS

A series of one-sample t-tests were performed to determine if the students who exited the lunch line first and those who exited last consumed at least one-third of the RDA for calories, vitamin A, vitamin C, calcium, and fiber. The findings are presented in Table 6. The groups were also compared to each other to determine any nutrients that were significantly different for students who received the most versus the least amount of table time. The data is summarized in Table 6.

Table 6: Nutrients Consumed by Students with the Most and Least Table Time Compared to one-third RDA and Between Groups

Nutrient	1/3 RDA	Mean ±SD Most Time (n=154)	$p-value^a$	Mean ±SD Least Time (n=152)	$p-value^a$	$p-value^b$ Between Groups
Vitamin A (IU)	667	1236.5 ± 1056.1	$\leq 0.001^a$	1223.1 ± 1228.8	$\leq 0.001^a$	0.9
Vitamin C (mg)	12	15.4 ± 8.7	$\leq 0.001^a$	12.4 ± 8.1	0.5	0.002^b
Fiber (g)	8.3	3.2 ± 2.1	$\leq 0.001^a$	2.8 ± 1.8	$\leq 0.001^a$	0.038^b
Calcium (mg)	433	365.5 ± 207.0	$\leq 0.001^a$	370.3 ± 190.8	$\leq 0.001^a$	0.833
Calories (kcal)	550	371.2 ± 164.1	$\leq 0.001^a$	342.3 ± 151.9	$\leq 0.001^a$	0.108

[a] $Statistical\ significance\ set\ at\ p < 0.05$

[b] $Statistical\ significance\ set\ at\ p < 0.05$

Vitamin A. Vitamin A recommendations for the elementary school age students is approximately 2,000IU per day, therefore approximately 667 IU should be provided by the school lunch period (USDA, 2013d & USDA, 2012a). Average intake in this study was approximately 1237 IU for students with the most table time and 1223 IU for students with the least table time (Table 6). Both were significantly above the amount that the children are recommended to receive from the school lunch. There was no significant difference between the two groups in the three-day average amount of vitamin A consumed (Table 6).

Vitamin C. Daily vitamin C recommendations for elementary school age students range from 25 to 45 mg per day (USDA, 2013d). The recommended amount that elementary children should receive in their meal is approximately 12 mg per day (USDA, 2012a). Average three-day intake was approximately 15 mg per day for students with the most

table time and was significantly above the recommended one-third RDA. For students with the least table time, the recommendation was met with average intake at approximately 12 mg (Table 6). While both groups met the one-third RDA target, those who received the most table time consumed significantly more vitamin C than those who received the least amount of table time ($p = 0.024$) (Table 6).

Fiber. Although official recommendations have not been made, a minimum of 8.3 g from the school lunch would be approximately one-third of the RDA. The official RDA has not been set, but an Adequate Intake (AI) of 25 to 31 g per day is recommended for children in this age group (National Research Council, 2005). Average intake was approximately 3.2 g per lunch period for students with the most table time. This was significantly lower than the recommendation ($p \leq 0.001$). For the students who received the least amount of table time, average intake was approximately 2.8 g and also significantly lower than the recommendation ($p \leq 0.001$) (Table 6). Those who received the most table time consumed significantly more fiber than those with the least amount of table time ($p = 0.038$) (Table 6).

Calcium. Daily recommendation for children is 1300 mg of calcium per day (USDA, 2013d). To meet one-third of the RDA, children would need to consume approximately 443 mg per day as part of the school lunch. Average three-day intake was approximately 366 mg for students with the most table time and significantly below the goal intake ($p \leq 0.001$). For students who received the least amount of table time, average calcium intake was approximately 370 mg, which was significantly below the recommended intake ($p \leq 0.001$) (Table 6). There was no statistical difference in consumption between those with the most and least amount of table time (Table 6).

Calories. USDA set calorie ranges for school lunches in order to maintain intakes within normal ranges. The calorie range for elementary students is 550 to 650 calories per day for lunch (USDA, 2012a). The students in this study who received the most table time had an average three-day intake of 371 calories, which was significantly below the recommended minimum of 550 calories ($p \leq 0.001$). Likewise, the students who received the least amount of table time consumed a slightly lower number of calories (approximately 342 calories), which was also significantly below the recommended minimum ($p \leq 0.001$) (Table 6). There was no statistical difference in the three-day average consumption of calories by those who received the most versus the least amount of table time (Table 6).

DISCUSSION

The purpose of the study was to evaluate the relationship between elementary school age students' table time at lunch and selected shortfall nutrients and calorie consumption provided by the reimbursable school meal. The study was in response to the ongoing question among school nutrition professionals and school administrators regarding the adequacy of the 20-minute school lunch period recommendation.

Primary analysis revealed that students who exited the lunch line first received significantly more time than those who exited last, for a difference of approximately 5.5 minutes. The average time for those with the most amount of table time was below the 20 minute recommendation. This observation was seen despite the school cafeteria being designated with two serving lines serving the same menu options. The difference also proved to negatively affect the consumption of two shortfall nutrients, those being

vitamin C and fiber. While students with longer time at the table consumed more vitamin C, the comparison of each group's (i.e., most and least table time) vitamin C consumption compared to one-third of the RDA (i.e., amount that should be provided by the school lunch meal) indicate both groups were meeting the target level (i.e., 12 mg) (USDA, 2012a). The menu items contributing the larger amounts of vitamin C included spaghetti with tomato sauce, zucchini, grapes, salsa and salad. Of these, the menu items best consumed by the students (i.e., majority of students that ate some of all) were the spaghetti with sauce, grapes and salad.

Like vitamin C, the five minute longer period of time at the lunch table positively impacted fiber consumption. In contrast, neither of the groups consumed enough fiber rich foods to meet the one-third RDA target recommendation of 9.3 grams (National Research Council, 2005). Only one of the menu items served over the three-day study period, that being refried beans, met the definition of an excellent source of fiber (i.e., 5 g per serving). The salad and sweet potato fries met the definition of a good source of fiber (i.e., 2.5 g per serving) (Fruits & Veggies More Matters, n.d.). The salad entrée option was selected by a small percentage of students and when chosen, most ate the toppings (e.g., cheese and meat) and left large portions of the salad greens. The sweet potato fries and refried beans were marginally eaten, with 86 percent and 69 percent, respectively, of students not eating the fiber-rich food items. In addition, the other fruits and vegetables that provided lesser amounts of fiber were generally not eaten by the students. Possible reasons for this might include fiber-rich foods being more difficult and time consuming to chew, which can be problematic for elementary school age students who frequently have loose baby teeth and permanent teeth emerging.

In addition, students may have preferred the entrée items to the fruits and vegetables due to taste preferences or perceiving the fruits and vegetables as unappealing. In focus group research conducted with adolescents, researchers concluded that taste preference and appeal are the factors that most influence their food choices (Neumark, Sztainer, Story, Perry and Casey, 1999). The Dietary Guidelines for Americans, 2010, identify fruits and vegetables as foods to encourage (USDA, 2010a). For this to occur, there may be need for school nutrition programs to provide further training to food production and meal service staff in promoting these important food items. The use of behavioral economic principles in school nutrition settings has shown promise in this area (Just, Wansink, 2009).

Of the nutrients not correlated to table time, students were consuming enough vitamin A from the reimbursable school meal to meet the one-third RDA target of 667 IU. Upon examination of the vitamin A rich foods and the foods that were most popular a full carton of milk provided students with 500 IU of the 667 IU required, with some to all of the milk being consumed by 74 percent of the students. Further, some students drank more than one carton of milk with their meal. Other vitamin A rich menu items included the entrees, with at least half of the items being consumed by more than 50 percent of students.

While students consumed enough milk to contribute adequate vitamin A, the findings suggest it was not enough to meet the one-third RDA target of 443 mg for students with the most table time, and trended toward not being enough for students with the least table time. The primary source of calcium for the students on most days was from milk, which contributed 300 mg of the 443 mg required. Furthermore,

approximately, 62 percent of students consumed a full carton of milk or more. There was no difference in students' consumption of total calcium from the meal between groups, and calcium consumption was not correlated with table time. The findings suggest that the required among of 8 fluid ounces of milk offered with each reimbursable meal may not be enough to meet the one-third RDA target.

Students with both the most and least amount of table time consumed similar amounts of calories from the school lunch, but neither group consumed an average daily amount over the three-day period to meet the grade group minimum of 550 calories. This finding suggests that while 20 minutes table time may be adequate time for students to consume enough food to meet the lunch targets for some shortfall nutrients, it may not be enough time for students to consume enough calories or fiber. This is important in that students may not have the energy needed to concentrate and optimize learning during the latter half of the school day. Furthermore, low consumption of calories and fiber at lunch may lead to a high hunger level in the after-school period prior to an evening meal, resulting in students consuming snack-type foods that are calorie dense and low in nutrients (Paulo et al., 2006). These types of eating behaviors often contribute to low consumption of nutrients of concern, such as fiber and calcium, and contribute to excessive energy intake and contribute to an unhealthy weight (USDA, 2010b).

LIMITATIONS

Limitations of the study included the sample size, which included only one elementary school. This school also had a very low percentage of free and reduced price lunches compared to the national average (28 percent versus 66 percent respectively).

The observations took place on 3 consecutive days instead of 3 randomly selected days, which may have influenced intake due to the time of year, other school activities, and activity of the children. In addition, the study may reveal different findings from season to season.

IMPLICATIONS FOR RESEARCH AND PRACTICE

Further research is needed in understanding the role of table time in the consumption of the school lunch. In addition to analyzing the length of time provided for students, research is needed to understand how various environmental effects can impact consumption. For example, having teachers interact with students during the lunch period to role-model consumption of fruits and vegetables and being available to open food packages may affect consumption among these students. Other practices that may need further attention are the use of non-nutritive foods to reward good behavior (e.g., low noise levels) in the cafeteria. Further research to provide insight on the importance of preparing and serving appealing food items may also demonstrate ways to improve intake among school age students. Future studies of this nature should also include the extent to which nutrition education in the classroom supports or impedes students' consumption of the school lunch.

CHAPTER V

CONCLUSION

The study question presented by the school nutrition professionals was based on whether the 20-minute table time recommendation was adequate to allow students the opportunity to consume enough of their meal at a comfortable pace and have adequate nutrient consumption. Although few students received the full 20 minutes of table time, the study was designed to determine whether the students who received more table time would consume more of the select shortfall nutrients and calories. It was hypothesized that students with the most table time would consume more of the nutrients and calories compared to students with the least amount of table time.

The table time analysis revealed that those students who exited the lunch line first received significantly more table time (5.4 minutes) than those who exited the lunch line last. Given this finding, the researchers then measured plate waste to determine nutrient and calorie consumption. It was shown that a positive correlation existed for table time and vitamin C and fiber consumption with students with more table time having higher intake of the nutrients, with stronger correlation between table time and fiber than vitamin C. In addition to this positive correlation it was also found that even the students receiving the most table time did not consume adequate amounts of fiber, calcium, or

total calories to meet the one-third RDA or recommended calories ranges as required by the NSLP.

Further research is needed to fully understand the many factors playing a role in adequate consumption of the school lunch program. While it is shown that table time is positively correlated with the consumption of some nutrients, additional factors are likely contributors to school lunch consumption. Further research is needed to address possible factors such as nutrition education, food marketing, presentation and appeal of food items, and staff role models for the children.

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APPENDICES

Oklahoma State University Institutional Review Board

Date:	Monday, April 01, 2013
IRB Application No	HE1326
Proposal Title:	Assessing the current recmmendation of 20 minutes table time in relation to school students' lunch meal consumption
Reviewed and Processed as:	Exempt

Status Recommended by Reviewer(s): Approved   Protocol Expires: 3/31/2014

Principal
Investigator(s):

Catherine Millburg	Summer Krlin	Deana Hildebrand
		315 HES
Stillwater, OK 74078	Stillwater, OK 74078	Stillwater, OK 74078

The IRB application referenced above has been approved. It is the judgment of the reviewers that the rights and welfare of individuals who may be asked to participate in this study will be respected, and that the research will be conducted in a manner consistent with the IRB requirements as outlined in section 45 CFR 46.

[X] The final versions of any printed recruitment, consent and assent documents bearing the IRB approval stamp are attached to this letter. These are the versions that must be used during the study.

As Principal Investigator, it is your responsibility to do the following:

1. Conduct this study exactly as it has been approved. Any modifications to the research protocol must be submitted with the appropriate signatures for IRB approval. Protocol modifications requiring approval may include changes to the title, PI, advisor, funding status or sponsor, subject population composition or size, recruitment, inclusion/exclusion criteria, research site, research procedures and consent/assent process or forms.
2. Submit a request for continuation if the study extends beyond the approval period of one calendar year. This continuation must receive IRB review and approval before the research can continue.
3. Report any adverse events to the IRB Chair promptly. Adverse events are those which are unanticipated and impact the subjects during the course of this research; and
4. Notify the IRB office in writing when your research project is complete.

Please note that approved protocols are subject to monitoring by the IRB and that the IRB office has the authority to inspect research records associated with this protocol at any time. If you have questions about the IRB procedures or need any assistance from the Board, please contact Dawnett Watkins 219 Cordell North (phone: 405-744-5700, dawnett.watkins@okstate.edu).

Sincerely,

Shelia M. Kennison

Shelia Kennison, Chair
Institutional Review Board

IRB Application

Catherine Millburg: Researcher & PI

Script for asking student's permission to take a picture of their school lunch tray

We are wanting to learn about what kids eat at school. Can we put this card on your tray and take a picture of your tray? Only the tray will be in the picture. *If the student responds 'no' no further communication will be held with the child.*

If the student responds 'yes,' the researcher will continue with the following:

When your table is dismissed, please leave your tray on the table with this card. I will take another picture and put your tray in the trash for you.

Researcher places number card on the tray and takes picture. The outside edges of the tray should align with the camera's lens frame.

How much time does it take for a student to eat a healthy school lunch?

Edmond Public Schools Child Nutrition Services in cooperation with Oklahoma State University is interested in learning how much time students need to eat their lunch. Representatives from OSU Department of Nutritional Sciences will be at Charles Haskell Elementary in April and May 2013 to help us answer this question.

What will the researchers do?
- Researchers will ask students in 2nd, 3rd and 4th grades if they can take a picture of their meal tray as they leave the meal service line.
  - No picture will be taken if a student responds 'no.'
  - For students who respond 'yes', a numbered card will be placed on the tray and a picture of **only the meal tray will be taken.** When the student is dismissed from lunch, a second picture of the tray will be taken.
  - At no time will the child be included in the picture or asked for his or her name.

How do the school & students benefit?
- School administrators will be able to schedule an optimum amount of time for students to eat.
- Students who have adequate time to eat school meals have better nutrition. Students who have better nutrition do better in school.

Who can participate?
- Any student who is in 2nd, 3rd or 4th grade enrolled at Charles Haskell Elementary.

Will my child be at risk?
- No. The procedures create no risks, discomforts or harm to the child.

What if I don't want my child to participate?
- Participation is voluntary. Instruct your child to tell the researcher 'no thank you' if he or she, or you do not want them to participate.
- Refusal to participate will not result in loss of benefits or privileges.

For more information
Contact:
deana.hildebrand@okstate.edu
405-744-5059
Deana Hildebrand, PhD, RD, SNS, LD
Oklahoma State University

Okla. State Univ.
IRB
Approved 4-1-13
Expires 3-31-14
IRB # HE-13-26

VITA

Catherine Millburg

Candidate for the Degree of Nutritional Sciences

Master of Science

Thesis: RELATIONSHIP BETWEEN LUNCH TABLE TIME AND STUDENTS'
CONSUMPTION OF VITAMIN A, VITAMIN C, CALCIUM, FIBER AND
CALORIES

Major Field: Nutritional Sciences

Biographical:

Education:

Completed the requirements for the Master of Science in Nutritional Sciences at
Oklahoma State University, Stillwater, Oklahoma in December, 2013.

Completed the requirements for the Bachelor of Science in Family and
Consumer Sciences with an emphasis in Dietetics at the University of
Wyoming, Laramie, Wyoming in 2011.

Experience:

Freshman Research Mentor under the supervision of Dr. Hildebrand. Includes
the supervision of 2 separate Freshman Research Scholars at Oklahoma
State University from 2012-2013.
Graduate Assistant under the supervision of Dr. Hildebrand including the
development of professional materials with child nutrition program
administrators.

Professional Memberships:

Academy of Nutrition and Dietetics
Oklahoma Academy of Nutrition and Dietetics