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TIME TO EAT SCHOOL LUNCH AFFECTS ELEMENTARY STUDENTS' NUTRIENT CONSUMPTION

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ABSTRACT

Purpose/Objectives

Advocacy groups recommend the school lunch period allow students 20 minutes of time to eat. While there is increasing evidence to support this recommendation, there is less known about the effect of eating time on nutrient consumption. The purpose of this study was to determine whether time to eat affected students' consumption of energy and select, under-consumed nutrients (i.e., vitamins A and C, fiber, and calcium) provided by the reimbursable school lunch.

Methods

The study was conducted over a 3-day period with 2nd through 4th grade students in Spring 2013 at an elementary school located in a Southwestern state. For each grade the first and last ten students in each of 2 serving lines were recruited each day. Nutrient consumption of 306 meals was calculated by using a visual food consumption method and the school's nutrient data base information. Minutes of eating time were calculated by subtracting the time stamp on pre-meal time photographs from each classes' lunch dismissal time. Independent sample t-tests compared 1) time to eat between the first and last groups and 2) students' nutrient consumption between groups and with NLSP nutrient standards for calories and select nutrients. A univariate analysis was used to compare mean eating times across the 3-day trail. Statistical significance was set at $p < 0.05$.

Results

The 25-minute lunch period did not provide students 20 minutes to eat lunch. The students entering the meal line first had significantly more time to eat (mean = 17.8 minutes, SD = 1.8) compared to students who entered the meal line (mean = 12.4 minutes, SD = 1.8, $p \leq 0.001$). While students who had more time to eat consumed more Vitamin C and fiber compared to students who had less eating time, neither group met fiber or total energy standards.

Applications To Child Nutrition Professionals

The findings can inform decisions regarding lunch duration to promote consumption of nutrients provided by the school lunch. Implementation can begin with inclusion in state and local level school wellness policies.

Keywords: **School lunch, lunch period duration, nutrient intake**

INTRODUCTION

Schools are consistently identified as an optimum setting for establishing health habits in children (IOM, 2012). Revisions to the school meal patterns authorized by the Healthy and Hunger Free Kids Act (2010) increased quantity of fruits and vegetables and variety of vegetables and whole-grains, while maintaining fat-free and low-fat milk to help ensure school age children are offered foods that provide the nutrients most lacking in children's diets (United States Department of Agriculture [USDA], 2012). These nutrients have been identified as vitamins A, C, D, calcium and fiber (USDA, 2015). The current school lunch meal pattern utilizes a food-based menu planning system, and is designed to meet approximately one-third of the age-specific Recommended Dietary Allowance (USDA, 2012; US Department of Health and Human Services [USDHHS] & USDA 2015). The school lunch meal provides a significant source of energy and nutrients to school age children, especially those that are at risk for food insecurity (USDA, 2012).

One question gaining attention is the amount of time students should be given to eat lunch while at school. 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, p. 4148). Several organizations, including the American Academy of Pediatrics (AAP), and Centers for Disease Control and Prevention (CDC), recommend 20 minutes of time to eat (AAP, 2005; CDC, 2018.). While time to eat is not defined, the CDC suggests it is the amount of time students are provided to eat lunch once they receive their meal (CDC, 2017).

There is a growing number of studies that have examined lunch duration in elementary school settings and time for consumption of school meal items. An early study conducted by Sanchez, et al., (1999) looked at three aspects including: 1) speed of service, 2) time at the table, and 3) busing of dishes. The researchers reported the 30-minute lunch period utilized an average of 4.25 minutes waiting in line; 23 minutes at the table for eating (8.5 minutes) and non-eating behaviors (14.5 minutes); and 36.5 seconds for busing dishes. The amount of time to actually eat the lunch meal was similar to the range of 7 to 12 minutes reported by two other research groups (Bergman, Buergel, Joseph & Sanchez, 2000; Conklin, Lambert & Anderson, 2002). This range of time did not include time spent socializing, preparing foods, using condiments or other non-eating behaviors. These studies suggest a 30-minute lunch period provides adequate time to eat lunch.

More recently, research has focused on the effect of lunch duration and eating time on elementary students' consumption of the school lunch meal. In 2004, Bergman et al. used a plate waste method to compare the relationship between the total length of the school lunch period and the nutrients consumed among elementary children. The researchers concluded that students with a 30-minute lunch period consumed significantly more vitamins and minerals compared to students who had a 20-minute lunch period. Cohen et al. (2016), reported similar results but used time to eat, rather than meal period, to compare meal consumption. They concluded that students who had more than 25 minutes eating time consumed more of the entrée, milk and vegetable meal components compared to students who had less than 20 minutes to eat. Because the reimbursable school lunch provides 1/3 of a students' daily nutrients, it is important to understand if a 30-minute lunch period is adequate to allow students the recommended 20-minutes to eat, and how the lunch duration and time to eat affects not only food consumption but also nutrient consumption.

The purpose of this study was to evaluate time to eat and the effect on consumption of the total calories and selected under-consumed nutrients of concern (USDHHS & USDA, 2015). Fiber, calcium, vitamin A, vitamin C, and total calories were evaluated to determine whether there was

an increased amount consumed by students who had more time to eat lunch (first of the line) compared to those who had less time (last in line). This study provides information for school administrators to better understand factors that support students' meal consumption and meeting recommended nutrient intake.

METHODS

The study was conducted in an urban elementary school located in a Southwestern state in Spring 2013. The school was self-selected due to their interest in the study question and to inform school schedule decision making. At the time of the study, the school had an enrollment of 927 total students, which included pre-kindergarten through 5th grade. Racial make-up of the school was 60% Caucasian and 18% African American (Office of Educational Quality and Accountability, 2013). Approximately 29% of the students were eligible for free or reduced price meals (Oklahoma State Department of Education, 2013).

The study was conducted over a 3-day period in 2nd through 4th grades. The study days were typical school days with no conflicting activities such as field trips, programs or classroom celebrations. Enrollment across grade levels was approximately 350 students, or 100-120 students per grade level. Each grade was level scheduled for a 25-minute lunch period. Students entered one of two identical serving lines offering the same menu. Meal service utilized the offer versus serve option and there were no self-service meal components (e.g., fruit or vegetable bar). Lunch room monitors assisted students with opening condiment packages as needed. Students with sack lunches were seated at dining tables without going through the meal service line unless they needed to purchase milk. For each grade group that entered the cafeteria, the first ten students and the last ten students in each line were recruited to participate in the study each day for a maximum of 360 observations over the 3-day study period; thus providing a quasi-random sample of students in the two study groups (i.e. longest time to eat and least time to eat). Of the 360 maximum observations, 306 resulted in usable data sets. The difference was accounted for by pre/post photos that could not be matched (e.g., students discarded their meal before the post-meal photo was taken or the card was misplaced) and 3 students who declined to participate.

The study was conducted as a thesis research project (Millburg, 2014) and 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 wish for their child to participate were instructed to inform their children to respond "no" when asked if a picture of the tray could be taken.

Time to eat

A digital camera used to photograph meal trays provided a time stamp recording the time the students left the meal service line. Because all children in a grade group were dismissed at the same time, one time was recorded for dismissal. Time to eat was calculated by subtracting the camera time stamp from the dismissal time signaling the end of the lunch period.

Nutrient consumption

Visual plate waste study methods were used to calculate the amount of food consumed by the students (Swanson, 2008; Hanks, Wansink, & Just, 2014). These methods included using a digital camera to take a series of two pictures for each student's meal. As students exited each of the two meal service lines, trained research assistants asked the first and last ten students of each grade group for permission to take a digital photograph of their meal tray. If the student agreed, 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. The student was instructed to eat as normal. The time to collect the data was approximately 15 seconds. Upon dismissal, the

students with numbered cards were asked to place their trays on the stage area; this was to avoid disrupting the next grade level entering the cafeteria. Prior to taking the post-meal photo, the weight of the milk carton was measured using a calibrated digital scale (Ohas Scales, CS Series, CS500-001) and recorded on the numbered card, then the card was placed back on the tray for the second photo.

To calculate the amount of food eaten, a trained research assistant matched the pre- and post-meal tray pictures using the number identification card. By comparing the matched pre- and post-photos, the proportion of food item eaten (i.e., 100%, 75%, 50%, 25%, 0%) was determined and recorded in the database. To determine accuracy of the assessment, a second trained research assistant reviewed a random sample of 10 percent of the matched meal trays. The accuracy of determining food item consumption was excellent, as indicated by interrater coefficients of 0.989 for entrees, 0.986 for vegetables, and 0.987 for fruits. Students' nutrient consumption was calculated by multiplying the proportion of each food item consumed by each student by the nutrient and calorie contribution of each food item. The nutrient contribution of each food item for the selected shortfall nutrients and calories per serving was obtained from the school district's nutrient data base and are summarized in Table 1.

Table 1: ***Daily Menu Items Served with Nutrient and Energy Contribution per Serving.***

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/ Ground 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 [a]	500	1.2	0	300	116
Salad Entrée [a]	6556	14.04	4.02	117.1	434
Ham & Cheese Sandwich [a]	19	1.06	4.0	356.5	227

[a] Menu items offered daily.

The quantity of milk consumed was calculated by weighing a full carton each of fat-free chocolate milk and vanilla milk, and fat-free unflavored milk. The weight of an empty carton was also measured 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 full chocolate milk carton – 0.5 ounce empty chocolate milk carton = 8.7 ounces of milk per container). The percentage of milk consumed was calculated and used for nutrient analysis based

on nutrient information obtained from the school's nutrition data base. Dietary Reference Intakes were used to estimate one-third of the RDA for elementary school age children (USDA, 2013d)

Statistical Analyses

Statistical analyses were conducted using SPSS software version 22.0 (Chicago, IL). Independent sample t-tests were used to compare minutes of eating time as well as nutrient consumption between students with the most and least amount of time to eat. A univariate analysis was used to compare mean eating times across the 3-day trail. The data was pooled across grade levels. Level of significance for all tests was set at $p < 0.05$.

RESULTS AND DISCUSSION

Time to eat

Over the 3-day study period, the first ten students in each grade and serving line who exited the serving line first (n=154) had significantly more time to eat than the ten students who entered last (n=152) *(p≤0.001)*. On average, the students in each grade group who entered, and exited, the serving line first had 5.4 more minutes of time to eat compared to those who entered and exited the serving line last (17.8 minutes versus 12.4 minutes, respectively). The pooled 3-day average reflects each of the individual days when evaluated separately. The longest eating times ranged from 18.0 to 17.7 minutes, and the shortest from 12.1 to 12.5. Within each of the 3 days, differences in eating time for the two groups were significantly different ($p < 0.01$). Across the 3 days, the mean eating time was similar (15.0, 15.0 and 15.3 minutes respectively; $p = 0.75$). The findings are summarized in Table 2. None of the students had 20 minutes to eat lunch, which is the recommended amount of time associated with increased consumption of the meal (Conklin, Lambert & Anderson, 2002; AAP, 2005; CDC, 2018; Cohen et al., 2016). To provide a full 20 minutes to eat, Conklin and colleagues (2002) recommended a 30-minute lunch period, allowing for up to 10 minutes of travel and serving time. In the current study, the school schedule allowed for a 25-minute lunch period, with students arriving at the front of the line having 8 minutes of travel and serving time. In contrast, students at the end of the serving line had a 13-minute wait, almost half of the lunch period, before arriving at the table. Based on these findings, there is support for a minimum 30-minute lunch period, which may need to be longer to accommodate school settings with long distances between the classrooms and cafeterias, have inadequate serving lines, less automated POS meal count systems or that have limited hand washing facilities for students.

Table 2: ***Comparison of Mean Time to Eat Between Study Group Observations and Daily Mean in 3-day Trial***

Observation day	Study group [a]	Mean ± SD	*p*-value	Daily mean ± SD	*p*-value
Day 1	First in line (n=55)	17.7 ±2.3 minutes	$p < 0.001$ [b]	15.0 ± 3.2 minutes	$p = 0.75$
	Last in line (n=57)	12.4 ±1.9 minutes			
Day 2	First in line (n=46)	17.6 ±1.5 minutes	$p < 0.001$ [b]	15.0 ± 3.0 minutes	
	Last in line (n=50)	12.5 ±1.7 minutes			
Day 3	First in line (n=53)	18.0 ±1.3 minutes	$p < 0.001$ [b]	15.3 ± 3.4 minutes	
	Last in line (n=45)	12.1 ±1.8 minutes			
3-day mean	First in line (n=154)	17.8 ±1.8 minutes	$p < 0.001$ [b]	15.1 ± 3.2 minutes	
	Last in line (n=152)	12.4 ±1.8 minutes			

[a] *First in line = first 10 students in each serving line per grade level; Last in line = last 10 students in each serving line per grade level*

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

Nutrient consumption

A series of one-sample t-tests were performed to determine if the students in the two study groups consumed at least one-third of the RDA for calories, vitamin A, vitamin C, calcium, and fiber. The groups were also compared to each other to determine any nutrients that were significantly different for students who had the most versus the least amount of time to eat. The data are summarized in Table 3.

Table 3: ***Comparison of Students' 3-day Mean Nutrient Consumption to One-third of the RDA and Between Study Groups***

		Study group: First in line [b]		**Study group: Last in line [b]**		**Between Group Comparison**
Nutrient	⅓ RDA[a]	Mean consumption±SD (n=154)	*p-value*	Mean consumption± SD (n=152)	*p-value*	*p-value*
Vitamin A (IU)	549.8	1239.2 ± 1112.5	< 0.001 [c]	1052.2 ± 1029.6	< 0.001 [c]	*0.128*
Vitamin C (mg)	11.6	15.8 ± 8.6	< 0.001 [c]	12.4 ± 8.6	0.26	0.001 [c]
Fiber (g)	7.7	3.3 ± 2.2	< 0.001 [c]	2.7 ± 1.8	< 0.001 [c]	0.004 [c]
Calcium (mg)	396	369.7 ± 201.0	0.110	369.3 ± 190.8	0.086	0.986
Calories (kcal)	550	373.0 ± 159.6	< 0.001 [c]	340.4 ± 158.7	< 0.001[c]	0.074

[a] *USDA, 2013b*

[b] *First in line = first 10 students in each serving line per grade level; Last in line = last 10 students in each serving line per grade level*

[c] *Statistical significance set at p < 0.05*

In this study all students had a 25-minute lunch period, with an eating time ranging from 17.8 minutes to 12.4 minutes. Consistent with the findings of Cohen et al. (2016), students who had more time to eat consumed more vitamin C and fiber compared to those with the least eating time. The difference was that in the Cohen study, students who ate more of the meal had more than 25 minutes to eat compared to less than 20 minutes of time to eat in this study. This short amount of eating time was associated with students' low consumption of fiber, a dietary component lacking in the diet of many children (Hoy & Goldman, 2013). In this study, regardless of the amount of time to eat, neither group consumed enough fiber-rich foods to meet the one-third RDA target recommendation of 7.7 grams (National Research Council, 2005). Fiber contributes to healthy gastrointestinal function and minimizes constipation, which is a common complaint among children especially when fruit and vegetable consumption is limited (van den Berg, 2006). While each day's menu offered an excellent (> 5 g/serving) or good source of fiber (> 2.5 g/serving), the menu items were marginally consumed by the students (see Table 4). The small percentage of students who selected the salad entrée tended to consume the meat and cheese topping. Of the students with sweet potato fries and refried beans on their trays, less than one-third of the students consumed the food items.

Table 4: ***Percentage of Students who Consumed None, Part or All of Each Menu Item***

Food Item n = observations	**Number of students selecting item** [a]	**None Eaten**	**25% Eaten**	**50% Eaten**	**75% Eaten**	**100% Eaten**
Day 1 (n = 112)						
Spaghetti	99	22%	7%	11%	10%	50%
Cheesy garlic breadstick	74	22%	7%	4%	0%	67%
Zucchini	34	90%	4%	0%	1%	5%
Side Caesar salad	25	64%	2%	8%	0%	26%
Pineapple	62	37%	4%	10%	7%	42%
Salad Entrée	2	0%	50%	0%	50%	0%
Ham Sandwich	1	-	-	-	-	100%
Day 2 (n = 96)						
BBQ Chicken Sandwich	74	41%	6%	10%	4%	39%
Sweet Potato Fries	15	86%	4%	2%	1%	7%
Corn	42	61%	3%	10%	5%	21%
Grapes	84	23%	4%	12%	5%	56%
Salad Entrée	19	32%	26%	26%	5%	11%
Ham Sandwich	0	-	-	-	-	-

Table 4: continued

Food Item n = observations	Number of students selecting item [a]	None Eaten	25% Eaten	50% Eaten	75% Eaten	100% Eaten
Day 3 (n = 98)						
Nachos w/ Gr. Turkey	104[b]	2%	12%	21%	23%	42%
Refried Beans	34	69%	10%	5%	3%	13%
Shredded Lettuce & Tomato	25	78%	5%	6%	0%	11%
Salsa	13	88%	0%	2%	1%	9%
Apple Slices	73	34%	12%	8%	9%	37%
Salad Entrée	0	-	-	-	-	-
Ham Sandwich	0	-	-	-	-	-
Milk (3-day mean)	101	13%	9%	9%	7%	47%

[a] *The school site implemented the offer versus serve provision; therefore, meal item counts do not equal observations.*

[b] *Number of entrees exceeded observations due to 6 students purchasing 2 entrees*

Using data from the NHANES 2009-2010 survey, Hoy and Goldman (2014) suggested that fiber intake is influenced by energy intake. In the current study, while students in both groups consumed similar amounts of calories from the school lunch, neither group consumed an average energy intake at lunch that met the USDA's minimum of 550 calories for kindergarten through 5th grades. This is important in that low energy and nutrient intake at mid-day may limit a student's ability to concentrate and optimize learning during the latter half of the school day (Winicki & Jemison, 2003). A report published by the USDA indicates that 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 (USDHHS & USDA, 2015). These types of eating behaviors often contribute to excessive energy intake resulting in an unhealthy weight (CDC, 2016).

While intake of fiber and calories were lower than the recommendations, students did consume adequate amounts of vitamin A, vitamin C and calcium, regardless of the amount of time they had to eat. This is logical in that the reduced and low-fat milk items were fortified with vitamin A and that 63 percent of students consumed 50 percent or more of their milk. Further, several of the high-consumed entrees (spaghetti, nachos w/ ground turkey and ham & cheese sandwich) provided substantial amounts of vitamin A and calcium.

The findings from this study should be considered with regard to known limitations. First, while the study had an adequate sample size and was conducted over a 3-day period, it was conducted in one elementary school. While the school had a large enrollment of more than 900 students, the rate of students who qualified for free and reduced price meals (28 percent) was low compared to the national average of 66 percent. Further, while the majority of the school's enrollment was Caucasian and was reflective of the racial distribution in Oklahoma (United States Census, 2017), it may not reflect other areas with different racial and ethnic distributions. While the study limits generalization, the findings do provide information to decision makers about the importance of providing sufficient time for students to consume school meals so that they are adequately nourished during the school day.

CONCLUSIONS AND APPLICATION

The findings of this study are corroborated by previous reports (Bergman et al., 2004; Cohen et al., 2016) that a minimum 30-minute lunch period provides students 20 minutes to eat lunch. The scheduled lunch period includes transportation time from the classroom to the cafeteria as well as time waiting in line to receive the school lunch. Once arrived at the meal line, the amount of time a student spends waiting on a given day may include, but is not limited to, the menu served, the degree of automation of the point-of-service (POS) meal count system, implementation of offer-versus-serve, and participation. Some of these factors are more modifiable than others but are worthy of consideration. Findings from the current study reflect that in this particular school, the menu served was not a factor in the amount of time a student had to eat.

While school administrators may not be able to add more time to the school day, they can explore ways to more quickly move children through the lunch line, including multiple service lines and alternate meal counting systems (Cohen et al., 2016). When space allows, schools may consider providing students with grab-and-go options such as sack lunches or pre-made entrée salads offered off the serving lines and pre-portioning side dishes. Schools that meet the criteria can implement USDA's Community Eligibility Provision, a non-pricing meal service option eliminating the need for a categorical checkout system (USDA, 2017).

Less than 20 minutes of eating time contributes to students' suboptimal intake of fiber and calories. In this study, menu items contributing fiber were dark-green, red-orange or legume vegetable components, which are required as part of the USDA weekly school meal pattern. This finding supports existing evidence that more time to eat is associated with students increased consumption of both fruits and vegetables (Cohen et al., 2016; Gosliner, 2014).

Consuming fruit and vegetables at school is especially important, particularly if availability of fruits and vegetables is limited in a student's home environment (Neumark-Sztainer, Wall, Perry, & Story, 2006). However, if students are not familiar with different varieties and have limited time to eat, the likelihood of the fruit and vegetable being consumed is reduced. Taste tests expose students to unfamiliar foods and helps to establish new taste preferences, which is correlated with fruit and vegetable intake (Larson, et al., 2008). Researchers suggest that up to ten exposures to a new food may be needed before preferences are established (Birch, 1999; Wardle et al., 2003). As such, school nutrition staff should be persistent in their efforts. While there are multiple approaches, school nutrition staff should utilize taste test approaches that do not further limit students' time to eat. One approach is conducting taste tests in classrooms as part of a nutrition education lesson. School nutrition programs that do not employ a nutrition educator can partner with a Farm to School coordinator or Cooperative Extension Family and Consumer Science educators through the state's land grant university. Schools may also access Cooperative Extension publications with techniques, ideas and safety tips for conducting taste testing in a variety of settings. Less formal testing can be accomplished by setting up "taste tables" in the cafeteria, offering samples on the serving line, or placing samples on a cart and circulating among tables (Action for Healthy Kids, 2015). These approaches are good opportunities to engage parent and community volunteers in the school meal program.

To optimize students' consumption of the school meals, school administrators and community members should review and revise school wellness policies to ensure inclusion of best-practice clauses that clearly communicate expectations for a full 20 minutes of time to eat lunch. This is best achieved with a total lunch period of not less than 30 minutes, and may need to be longer, depending on individual school situations. A recent analysis of the 2014 *School Health Policies and Practices Study* reflects that state level school wellness policies requiring engagement of school stakeholders in school meal programs are associated with school practices that promote

lunch consumption. These practices include taste tests and the duration of lunch periods (Turner et al., 2018). Future research is needed to replicate the study in a variety of school settings and grade levels to ensure generalization of findings.

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