



Amount of Time to Eat Lunch Is Associated with Children's Selection and Consumption of School Meal Entrée, Fruits, Vegetables, and Milk

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ARTICLE INFORMATION

Article history:

Submitted 16 April 2015
Accepted 24 July 2015

Keywords:

School lunch
Lunch period length
Fruit intake
Vegetable intake
Milk intake

Supplementary materials:

Podcast available at www.andjrn.org/content/podcast/

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<http://dx.doi.org/10.1016/j.jand.2015.07.019>

ABSTRACT

Background There are currently no national standards for school lunch period length and little is known about the association between the amount of time students have to eat and school food selection and consumption.

Objective Our aim was to examine plate-waste measurements from students in the control arm of the Modifying Eating and Lifestyles at School study (2011 to 2012 school year) to determine the association between amount of time to eat and school meal selection and consumption.

Design We used a prospective study design using up to six repeated measures among students during the school year.

Participants/setting One thousand and one students in grades 3 to 8 attending six participating elementary and middle schools in an urban, low-income school district where lunch period lengths varied from 20 to 30 minutes were included.

Main outcome measures School food selection and consumption were collected using plate-waste methodology.

Statistical analyses performed Logistic regression and mixed-model analysis of variance was used to examine food selection and consumption.

Results Compared with meal-component selection when students had at least 25 minutes to eat, students were significantly less likely to select a fruit (44% vs 57%; $P < 0.0001$) when they had < 20 minutes to eat. There were no significant differences in entrée, milk, or vegetable selections. Among those who selected a meal component, students with < 20 minutes to eat consumed 13% less of their entrée ($P < 0.0001$), 10% less of their milk ($P < 0.0001$), and 12% less of their vegetable ($P < 0.0001$) compared with students who had at least 25 minutes to eat.

Conclusions During the school year, a substantial number of students had insufficient time to eat, which was associated with significantly decreased entrée, milk, and vegetable consumption compared with students who had more time to eat. School policies that encourage lunches with at least 25 minutes of seated time might reduce food waste and improve dietary intake.

J Acad Nutr Diet. 2015; ■:■-■.

THE NATIONAL SCHOOL LUNCH PROGRAM IN THE United States provides free or inexpensive meals to > 30 million students every day.¹ Many children from low-income families rely on school meals for nearly half of their daily energy intake.² Therefore, policies that improve the school food environment can have important public health implications in addressing the growing socioeconomic disparities in the prevalence of obesity and in improving the overall nutrient quality of children's diets.³

Recently, the Healthy Hunger-Free Kids Act of 2010 enhanced the nutritional quality of school meals and set nutrition standards for competitive food sold in schools, which has resulted in improvements in student's school food selection and consumption.^{4,5} However, current national standards do not address lunch period length, which can

result in many students having insufficient time to eat their meals. Students frequently have lunch periods that are 20 minutes or less, which can be an insufficient amount of time to eat.^{6,7} A previous study conducted by Bergman and colleagues⁸ examined lunch-period length and found that students with 30-minute lunch periods consumed more foods and nutrients than those with 20-minute lunch periods. Their study examined aggregate food consumption, but did not differentiate between the types of foods consumed by students (eg, entrées, fruits, vegetables, or milk). A similar study found that longer lunch periods were associated with increased odds of consuming a fruit or vegetable, but the amounts consumed were not assessed.⁹

In addition, lunch-period length might not reflect the amount of time that students actually have to eat because

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students typically spend a considerable amount of time waiting in line to receive school-prepared lunches.^{10,11} In a survey of school cafeteria managers, 44% of respondents reported that students did not have enough time to eat, which they believed resulted in increased plate waste.¹² Similarly, surveys of students have found that a high percentage felt rushed at lunch and report insufficient time to eat their meal.¹³ Consuming food too quickly is associated with adverse gastrointestinal hormone responses to the meal and with decreased perceived satiety post consumption, which can increase the risk of overweight.^{14–16} Therefore, it is important to examine whether students have sufficient time to eat their meals and the association between time to eat with school food selection and consumption, which is currently unknown.

To address this gap in knowledge, the amount of time students had to eat school food was examined for associations with selection and consumption. This study was conducted during the course of the 2011 to 2012 school year among elementary and middle school students attending control schools participating in the Modifying Eating and Lifestyles at School (MEALS) study with varying lunch period lengths in a large, urban school district.

METHODS

Study Design and Participants

Data for the study were collected on 6 nonconsecutive days throughout the 2011 to 2012 school year as part of the MEALS study, a large, school-based randomized controlled trial. The MEALS study was a collaboration between the nonprofit organization Project Bread (www.ProjectBread.org) and the Harvard T. H. Chan School of Public Health to improve the selection and consumption of healthier school foods using a chef-based model and/or choice architecture (ie, environmental modifications to “nudge” consumers toward healthier options).¹⁷ The present study focuses on the six control schools with set lunch-period times (ie, schools without rolling lunch periods), and were elementary, middle, and kindergarten through grade 8 schools located in a low-income, urban school district in Massachusetts. Among the participating schools, three schools had a 30-minute lunch period, two schools had a 25-minute lunch period, and one school had a 20-minute lunch period. The majority of the students attending these schools were eligible for free or reduced-price meals (range=88% to 94%) and all schools were implementing the Offer Versus Serve provision, which allows students to select only three of the five meal components offered (ie, fruit, vegetable, milk, grain, and meat/meat alternative) and these meal components were available to students throughout all of the lunch periods. Competitive foods (ie, snacks sold in vending machines or à la carte) were not available in these schools and recess occurred after lunch in the elementary schools. Only traditional lunch periods were measured (ie, special feeding programs, such as At-Risk Afterschool Meals programs, were not included).

Students participated in the study if they received a school lunch on a study day (schools participating in the study had closed campuses). The study sample included students in grades 3 through 8 who were recruited using active consent methods that included parental consent, student assent, and a survey that asked parents for demographic information

(eg, child sex, grade, and race/ethnicity). Of the eligible population, 30.1% provided active consent. Previous analyses have indicated that there were no significant differences in food selection or consumption between students who actively consented and those who did not.^{5,17}

Data Collection Measures

Lunch period times and lengths were reported by the schools and verified by research assistants (RAs) on data-collection days. Consumption was determined using established plate-waste study methods collected on randomly selected, nonconsecutive days in the fall (n=2 days), winter (n=2 days), and spring (n=2 days) of the 2011 to 2012 school year (n=6 days total).^{18,19} The study days were randomly selected for plate-waste measurements without prior knowledge of what was being served.

On each study day, RAs arrived before the beginning of the first lunch period to provide each tray with a unique identifying number and to remove trash cans from the cafeteria. RAs weighed 10 random samples of each food offered on a food scale (Oxo 1130800), which provided a stable pre-consumption estimate of the foods served that day. Students then entered the cafeteria when the lunch period began and selected their school meals. As students left the lunch lines, RAs stood discreetly by the exits and recorded the tray number, the food components, and the time using synchronized watches. An announcement was also made at the beginning of lunch periods reminding students about the study and that participation was voluntary. Students who had provided active consents were asked to include their names on their trays. After the meal ended, RAs collected all of the trays and weighed each remaining meal component individually. The amount of time that students had to eat was calculated as the interval between the time they exited the lunch line and the end of the lunch period (students were not allowed to leave the cafeteria until the end of the lunch period). This study was approved by the Committee on Human Subjects at the Harvard T. H. Chan School of Public Health and all participants provided written informed consent and child assent.

Statistical Analyses

Data from the 1,001 students with active consent at the participating schools were included in the analyses (30.1% of all eligible students in the participating schools). Differences in the student and school characteristics across the schools were examined using the Mantel-Haenszel χ^2 test for categorical characteristics and analysis of variance for continuous characteristics. Logistic regression with multilevel modeling was used to examine differences in school meal component selection, accounting for the repeated measures of students nested within schools (SAS PROC GLIMMIX, version 9.4, 2013, SAS Institute). To examine consumption among students who selected a meal component, mixed-model analysis of variance was used, accounting for the repeated measures of students and school as a random effect (students nested within schools), using SAS PROC MIXED (version 9.4, 2013). All analyses adjusted for students' sex, grade, race/ethnicity, and time of the lunch period (morning [start time of 11 AM to before 12 PM], midday [start time of 12:00 PM to before 12:30 PM], or afternoon [start time of 12:30 PM to 1 PM]).

RESULTS

The characteristics of the students and schools participating in the MEALS study are presented in Table 1. In the participating schools, the lunch-period lengths reported by the schools ranged from 20 to 30 minutes. However, students were able to arrive early or late to lunch, resulting in significant differences across the schools in the amount of seated time to eat (excluding time spent traveling to the cafeteria or waiting in the lunch line) ranging from 10 to 33 minutes (mean 23.9 minutes; $P<0.0001$). Among schools with 30-minute lunch periods, a mean of 61% of the students had <25 minutes of seated time to eat their meals and 9% had <20 minutes on any given day. In the school with the 20-minute lunch period, the majority of students were able to arrive slightly early, but 100% still had <25 minutes to eat, and a mean of 65% of the students had <20 minutes (17% of students had <15 minutes) to consume their meal.

Overall, students were significantly less likely to select a fruit if they had <20 minutes to eat their meal compared with having at least 25 minutes (44.4% vs 57.3%; $P<0.0001$; Table 2). Similarly, selection of fruits was significantly lower when students had between 20 and 24 minutes to eat compared with when students had at least 25 minutes (46.9% vs 57.3%; $P<0.0001$). Selection of entrées, vegetables, and milk was not associated with the amount of time to eat.

Despite little difference in the selection of most meal components, consumption was significantly associated with the amount of time to eat (Table 3). Students who had <20 minutes to eat consumed a mean of 12.8% less of their entrées

compared with when students had at least 25 minutes (64.4% vs 77.2%; $P<0.0001$). Using the same comparison group, when students had <20 minutes, they consumed significantly less of their vegetables (34.8% vs 46.6%; $P<0.0001$) and milk (62.3% vs 72.6%; $P<0.0001$). Students with between 20 and 24 minutes to consume their meal also consumed significantly less of their entrée (70.3% vs 77.2%; $P<0.0001$) and vegetables (42.9% vs 46.6%; $P=0.04$) compared with student with at least 25 minutes to eat.

DISCUSSION

In this large study with detailed collection of selection and consumption of school meals, the amount of time children had to eat varied considerably within a standard 20- to 30-minute lunch period and, importantly, was associated with the selection and consumption of essential components of the school lunch. When students had <20 minutes of seated time to eat, they were less likely to select a fruit. In addition, although the selection of the entrée, milk, and vegetable did not differ appreciably among children with the shorter seated time, consumption of these mandatory components was significantly lower. These findings provide evidence that policies at the district, state, or national level may be warranted to ensure all children have sufficient time to eat their meals in schools, especially with the new mandatory national school lunch guidelines that require selection of a fruit or vegetable to qualify for a reimbursable school lunch.

Table 1. Characteristics of the students and schools participating in the Modifying Eating and Lifestyles at School study with varying amounts of time to eat lunch (n=1,001 students; n=6 schools)

Characteristics	All (n=1,001)	School 1 (n=99)	School 2 (n=245)	School 3 (n=217)	School 4 (n=102)	School 5 (n=234)	School 6 (n=104)	P value ^a
← n (%) →								
Female sex	541 (54.0)	65 (65.7)	133 (54.3)	115 (53.0)	47 (46.1)	132 (56.4)	49 (47.1)	0.01
Race/ethnicity								
Hispanic	877 (87.6)	86 (86.9)	221 (90.2)	189 (87.1)	89 (87.3)	198 (84.6)	94 (90.4)	0.07
Non-Hispanic								
Asian	33 (3.3)	6 (6.1)	9 (3.7)	11 (5.1)	4 (3.9)	1 (0.4)	2 (1.9)	
Black	24 (2.4)	1 (1.0)	9 (3.7)	2 (0.9)	1 (1.0)	9 (3.8)	2 (1.9)	
White	67 (6.7)	6 (6.1)	6 (2.4)	15 (6.9)	8 (7.8)	26 (11.1)	6 (5.8)	
← mean (range) →								
Age, y	11.6 (8.4-15.6)	9.9 (8.4-11.6)	12.7 (10.5-15.2)	11.7 (8.8-15.3)	9.9 (8.4-11.5)	12.8 (9.9-15.6)	10.4 (8.8-12.3)	0.92
Grade	5.3 (3-8)	4.0 (3-5)	6.4 (5-8)	5.3 (3-8)	3.5 (3-4)	6.5 (5-8)	4.1 (3-5)	0.36
Lunch period length, min ^b		30	30	30	25	25	20	<0.0001
Time to eat, min ^c	23.9 (10-33)	26.6 (20-33)	25.7 (20-33)	27.0 (17-33)	22.2 (11-28)	21.7 (11-28)	18.5 (10-23)	<0.0001

^aMantel-Hansel χ^2 test for categorical variables and analysis of variance for continuous variables.

^bLunch period refers to the length of time reported by the schools that the cafeteria is open for meal service (students are able to arrive early or late). The lunch period length is a fixed time determined by the school.

^cTime to eat refers to the amount of seated time students have to eat during the lunch period, excluding time spent traveling to the cafeteria and waiting in lunch lines.

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Table 2. Meal component selection among students participating in the Modifying Eating and Lifestyles at School study by the amount of time to eat lunch at school

Meal component	Time to Eat ^a						
	≥25 min (Reference) (n=561)	20 to 24 min (n=336)			<20 min (n=104)		
	Mean % ^b	Mean % ^b	Difference ^c	P value ^d	Mean % ^b	Difference ^c	P value ^d
Entrée	100	100	0	NA ^e	100	0	NA
Fruit	57.3	46.9	−10.4	<0.0001	44.4	−12.9	<0.0001
Vegetable	74.8	71.7	−3.1	0.33	77.0	2.2	0.45
Milk	72.0	69.4	−2.6	0.40	69.6	−2.4	0.66

^aTime to eat refers to the amount of seated time students have to eat during the lunch period, excluding time spent traveling to the cafeteria and waiting in lunch lines.

^bResults are unadjusted.

^cDifference calculated by subtracting the estimate from the reference group of Time to Eat: ≥25 minutes.

^dCalculated using logistic regression, with school as a random effect and repeated measures among students, adjusting for students' sex, race/ethnicity, time of the lunch period.

^eNA=not applicable.

Having a limited amount of time to eat had a noteworthy association with fruit selection. This might be due the fact that students with less time to eat were at the end of the lunch line and/or had arrived late to the cafeteria and were therefore trying to rush through the lunch line to maximize their amount of time to eat. It is also possible that these students recognized they would have less time to eat and therefore only selected foods they were likely to consume. Another important finding was that students ate significantly less of their entrée, milk, and vegetable when they had <20 minutes to eat compared with when students had at least 25 minutes to eat, suggesting that they likely did not have enough time to fully consume their meal.

Foodservice staff, teachers, students, and parents have echoed concerns that implementation of the Healthy Hunger-Free Kids Act has led to increases in food waste.²⁰ Although research suggests that waste levels of school foods have not increased, studies do indicate that there were and still are high levels of food waste in school cafeterias, even after implementation of the new school lunch guidelines.^{5,21} The

overall waste levels seen in this study were similar to those found previously in studies examining food waste in schools.^{5,22} This research suggests that enabling students to have sufficient time to eat their meals can help address this important issue.

School lunch is not only a time for children to eat, but also to socialize. Previous research documenting how students spend their time in cafeterias found that students require at least 20 minutes seated at a lunch table to allow for enough time to socialize and consume their foods.⁷ This study concluded that a 30-minute lunch period would enable most students to have a sufficient amount of seated time in cafeterias, taking into account travel time to the cafeteria and waiting in line for food. Our study also found that a 30-minute lunch period would enable almost all students to have at least 20 minutes to eat their lunch (91%), although the results of this study also suggest that there were additional benefits to at least 25 minutes of seated time. However, the majority of students did not have this amount of time to eat, even with a 30-minute lunch period.

Table 3. Meal component consumption among students participating in the Modifying Eating and Lifestyles at School study by the amount of time to eat during the school lunch period

Meal component	Time to Eat ^a						
	≥25 Min (Reference)	20 to 24 Min			<20 Min		
	Mean ^b (SE ^c)	Mean ^b (SE)	Difference ^d	P value ^e	Mean ^b (SE)	Difference ^d	P value ^e
Entrée (% consumed)	77.2 (3.2)	70.3 (3.2)	−6.9	<0.0001	64.4 (3.5)	−12.8	<0.0001
Fruit (% consumed)	63.8 (4.3)	63.7 (4.3)	−0.1	0.93	63.9 (5.0)	0.1	0.99
Vegetable (% consumed)	46.6 (7.1)	42.9 (7.0)	−3.7	0.04	34.8 (7.3)	−11.8	<0.0001
Milk (% consumed)	72.6 (4.2)	70.3 (4.1)	−2.3	0.14	62.3 (4.5)	−10.3	<0.0001

^aTime to eat refers to the amount of seated time students have to eat during the lunch period, excluding time spent traveling to the cafeteria and waiting in lunch lines.

^bCalculated using least squares mean regression.

^cSE=standard error.

^dDifference calculated by subtracting the estimate from the reference group of ≥25 minutes to eat.

^eResults are calculated among students who selected the meal component using mixed-model analysis of variance, with school as a random effect and repeated measures among students, adjusting for students' sex, race/ethnicity, time of the lunch period.

Although not all schools will be able to accommodate longer lunch periods, several other factors have been cited as areas where schools can improve the amount of time students have to eat. Increasing the number of serving lines, more efficient cashiers, and/or an automated point of sales systems can all lead to enhanced efficiency for students going through lunch lines.⁷

This study had several limitations. This study was conducted before implementation of the updated school meal standards that require students to select a fruit or vegetable. Therefore, it is possible that under the new guidelines, the decreases in fruit selection found in this study with less time to eat might no longer be observed. The participating schools were all located in an urban, low-income, primarily Hispanic school district and only elementary and middle schools were involved in this study. Future studies examining the effects of lunch period lengths and the amount of time to eat on selection and consumption in high schools in other race/ethnic communities and in populations with more middle- and higher-income students are warranted. It is also possible that the students who participated using active consents were different from the general population at the participating schools. However, previous analyses comparing selection and consumption among students with active and passive consents in the MEALS study found no significant differences among these two groups.^{5,17} An additional limitation is that students' food preferences were not assessed. Future studies should examine students' taste preferences for the foods offered as this likely impacts selection and consumption. It is also possible that some students who brought lunches from home shared some of the school meals. However, almost all students in these schools received a school meal and, therefore, if this occurred it would have a minimal impact on the study results. This study was also strengthened by the 6 days of plate-waste measurements at each school and the large sample size.

CONCLUSIONS

To our knowledge, this study is the first to examine the association between the amount of time students have to eat and school food selection and consumption. Findings from the current study suggests that policies that enable students to have at least 25 minutes of seated time might lead to improvements in students' diets and decrease plate waste in school cafeterias. Future studies examining whether time to eat is still associated with decreased fruit selection, given that the updated standards require students select a fruit or vegetable, and how this impacts overall consumption are warranted. Future research examining time to eat and school meal selection and consumption in other diverse school districts, as well as qualitative assessments, including interviewing students about the length of the time to eat in cafeterias and plate waste, are necessary.

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STATEMENT OF POTENTIAL CONFLICT OF INTEREST

No potential conflict of interest was reported by the authors.

FUNDING/SUPPORT

This study was funded by a grant from Arbella Insurance. J. F. W. Cohen is supported by the Nutritional Epidemiology of Cancer Education and Career Development Program (R25 CA 098566).