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Factors Associated with School Lunch Consumption: Reverse Recess and School "Brunch"

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ABSTRACT

Background While school foods have become healthier under the Healthy, Hunger Free Kids Act, research suggests there is still substantial food waste in cafeterias. It is therefore necessary to study factors that can impact food consumption, including holding recess before lunch ("reverse recess") and starting lunch periods very early or very late.

Objective This study examined the association between the timing of recess (pre-lunch vs post-lunch recess), the timing of the lunch period, and food consumed by students at lunch.

Design We conducted a secondary data analysis from a repeated cross-sectional design.

Participants/setting An 8-week plate waste study examining 20,183 trays of food was conducted in New Orleans, LA, in 2014. The study involved 1,036 fourth- and fifth-grade students from eight public schools.

Main outcome measures We measured percent of entrées, fruit, vegetables, and milk consumed by students at lunch.

Statistical analyses performed We used mixed-model analyses, controlling for student sex, grade, and the timing of the lunch period, and examined the association between reverse recess and student lunch consumption. Mixed-model analyses controlling for student sex, grade, and recess status examined whether the timing of the lunch period was associated with student lunch consumption.

Results On average, students with reverse recess consumed 5.1% more of their fruit than students with post-lunch recess (P=0.009), but there were no significant differences in entrées, vegetables, or milk intake. Compared to students with "midday" lunch periods, on average students with "early" lunch periods consumed 5.8% less of their entrées (P<0.001) and 4.5% less of their milk (P=0.047). Students with "late" lunch periods consumed 13.8% less of their entrées (P<0.001) and 15.9% less of their fruit (P<0.001).

Conclusions Reverse recess was associated with increased fruit consumption. "Early" lunch periods were associated with decreased entrée and milk consumption, and "late" lunch periods were associated with decreased entrée and fruit consumption. Additional research is recommended to determine whether these associations are causal.

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AMERICA IS EXPERIENCING A CHILDHOOD OBESITY epidemic. Over the past 30 years, the prevalence of childhood obesity in the United States has doubled among children ages 6 through 11 years and quadrupled in adolescents ages 12 through 19 years.[1,2] An unhealthy diet is a major risk factor for developing obesity.[3-6] Given that many students rely on school meals for up to half of their daily calorie intake, schools are important venues for improving childhood nutrition and preventing obesity.[7-9] On an average school day, more than 30 million children participate in the National School Lunch Program (NSLP); thus, improving dietary intake through school lunch has enormous potential to improve children's diets.[10]

Recognizing this potential, in 2010 Congress enacted the Healthy, Hunger Free Kids Act to realign the nutritional standards of school meals with the most current version of the Dietary Guidelines for Americans.[11] As a result, school foods have become a healthier source of calories for children.[12-14] However, research demonstrates that school lunch consumption among NSLP participants is still much lower than desired.[15-18]

One proposed intervention to increase school lunch consumption at elementary and middle schools is "reverse recess" (holding recess before lunch instead of after lunch). The idea behind reverse recess is twofold: first, if students expend energy before lunchtime, they may be hungrier and

consume more of their school lunch.[19] In addition, reverse recess may prevent students from skipping or rushing through lunch in order to play.[19] The National Association of State Boards of Education's State School Healthy Policy Database indicates that some states, including Colorado, Kansas, Maryland, Maine, and Michigan, recommend that schools implement recess before lunch.[20] According to the 2014 School Health Policies and Practices Study, a national survey conducted to assess school health policies among a nationally representative sample of schools, 11.3% of participating schools had regularly scheduled recesses before lunch for all of their classes.[21] However, a 2005 qualitative study by Rainville and colleagues[22] indicated that there are barriers to implementing reverse recess; school administrators cited the following perceived barriers to reverse recess implementation: preservation of morning hours for academics; logistical concerns of supervision, hand washing, and cold-weather clothing; possible resistance by faculty, staff, and parents; and tradition.

Thus far, research examining the impact of reverse recess has been mixed. Results from a study in 1996 by Getlinger and colleagues[23] indicated that when recess was scheduled before lunch, overall food waste decreased from 34.9% to 24.3%. In a 2004 study, Bergman and colleagues[24] found that students with recess before lunch consumed significantly more food and nutrients than students with recess after lunch (40.7% vs 27.2%). In addition, in a 2014 study, Price and Just[25] concluded that children ate 0.157 more servings of fruits and vegetables in schools that switched recess to before lunch (a 54% increase relative to baseline rates). A 2016 plate waste study by Strohbehn and colleagues[26] found that entrée, fruit, and vegetable waste was higher among schools with recess after lunch compared to schools with recess before lunch.

Other studies of reverse recess have not found statistically significant results. In 2005, Tanaka and colleagues[27] found a slight, but nonsignificant decrease in lunch waste after switching to reverse recess in one elementary school. In 2014, Hunsberger and colleagues[19] found that entrée, vegetable, and fruit consumption did not differ by pre- vs post-lunch recess; however, students with recess before lunch were almost 20% more likely to drink the entire carton of milk compared to students with recess after lunch (42% vs 25%; $P<0.001$). An evaluation of a pilot project in four Montana schools in 2003 found that reverse recess resulted in higher consumption of foods at lunch, but results were not statistically significant.[28] Lastly, a study from Fenton and colleagues[29] in 2015 found no association between reverse recess and fruit and vegetable consumption across the entire sample of students; however, the researchers did find that reverse recess was associated with increased fruit and vegetable consumption among girls. It is important to note that several of these studies were completed in a small numbers of schools; the researchers may not have obtained large enough samples to meet the statistical needs of their studies in terms of adequate power to test their hypotheses and desired precision of school-level estimates. Overall, the mixed findings of these studies support further examination of the impact of reverse recess on school lunch consumption.

The timing of school lunch may also influence food waste in schools. As there are only federal recommendations, not requirements, regarding the time of day that schools should offer lunch, lunch period start times vary dramatically throughout schools in the United States.[30] There has been little research examining associations between the time of school lunch periods and student lunch consumption. A 1996 survey of NSLP cafeteria managers indicated that 42% of managers believed that one reason for plate waste is that children are "not hungry."[31,32] However, the report did not specify whether the timing of the lunch period was the cause of students' lack of hunger.[31,32] In addition, a 2015 assessment of school lunch seat-time in Seattle Public Schools found that earlier lunch periods were linked to the highest plate waste.[33]

Given the inconsistent findings around the impact of reverse recess, and the relatively few studies that have examined this after implementation of the updated school meal standards, the present study examined the impact of reverse recess and the timing of the lunch period on student lunch consumption using plate waste data from eight elementary schools in New Orleans, LA.

MATERIALS AND METHODS

Study Population

The Louisiana Public Health Institute originally collected this study's data in 2014 as part of an 8-week plate waste study evaluating the Healthy School Food Collaborative, an initiative that formed in 2012 with an aim to improve the nutritional standards of school lunch in New Orleans. To obtain a sample of schools, Louisiana Public Health Institute recruited public schools throughout New Orleans. To be eligible for recruitment, schools needed to have a free or reduced lunch rate of at least 80%, a student body that consisted of at least 80% racial/ethnic minority students, a "school performance score" of "B" or less, and include grades four and five. Out of 58 public elementary schools in New Orleans, 40 were eligible to participate. The first eight schools that met the criteria, were contracted with a Healthy School Food Collaborative–member vendor for foodservice, and agreed to participate were enrolled in the original study. The original study was reviewed and approved by Sterling Institutional Review Board in Atlanta, Georgia. Permission to participate in the original study was obtained using passive consent because no identifiable data was collected and the study procedures were minimal risk.

Data Collection

Data were collected between January 30, 2014 and April 4, 2014 among fourth- and fifth-grade students. All fourth- and fifth-grade students in each of the eight schools were eligible to participate in the study. The final sample consisted of data collected from 1,036 students.

The outcome of interest, percent of lunch consumed per student, was determined by conducting an 8-week plate waste study. Louisiana Public Health Institute's plate waste methods were modeled after those implemented by Cohen and colleagues.[34] To ensure efficient and reliable data collection, a team of research assistants (RAs) and school lunch staff were trained on the study's protocol before data collection. Thirty-two days of data were collected from each school on average; 20,183 trays were examined in total.

At the beginning of each school's day of data collection, two RAs retrieved 10 standard lunches from the cafeteria staff and measured the weights (in grams) of each food item being served that day. From these 10 weights, the mean "pre-lunch"

weight of each food item was calculated. RAs also labeled lunch trays with unique identification numbers and removed all trashcans from the cafeterias to prevent students from throwing away their lunches.

When the lunch periods began, RAs stood by the cafeteria's cash registers and recorded each student's tray number, sex, and chosen lunch items on a data collection form. Students were instructed not to share or trade food and to leave their trays on the table when they finished eating. At the end of the lunch period, RAs collected the trays and recorded the weights of each individual item on every lunch tray using the tray identification number. Weights were recorded separately for entrée, vegetable, fruit, and milk. The percent of each meal component consumed was then calculated using the average of the standard pre-weights and the post-weights of each item (post-weight/pre-weight×100). All food was weighed using a digital scale (Good Grips Food Scale Model Number 1130800; OXO).

Data were also collected on the timing of the lunch periods and the reverse recess status for each school. Two of the schools had recess before lunch, three schools had recess after lunch, two schools had a combination of pre- and post-lunch recess (varied by grade), and one school did not have recess. The timing of the lunch periods varied from starting as early as 10:45 AM to ending as late as 1:15 PM across the eight schools. The "timing of the lunch period" variable was categorized as "early," "mid," and "late" lunch periods. Early lunch periods included lunches that started between 10:45 and 11:30 AM. Mid lunch period start times spanned from 11:55 AM to 12:15 PM. Late lunch period start times ranged from 12:25 to 12:55 PM. Reverse recess status was categorized as schools that had recess before lunch and schools that did not have recess before lunch (ie, after lunch or no recess).

Data Analysis

Mixed-model analyses, with school as a random effect (which accounts for the correlation of children within schools) examined differences in the consumption of entrées, fruits, vegetables, and milk between schools with recess before lunch and those with recess after lunch or no recess. Analyses adjusted for student sex, student grade, and timing of the lunch period. When examining differences in consumption by the timing of the lunch period, analyses adjusted for recess status, student sex, and student grade and accounted for students nested within schools. In all models, the day of the week and average lunch period length were also examined as potential covariates, but were not significant predictors of meal consumption and, therefore, were not included in the final models. In addition, five of the eight schools were part of the Healthy School Food Collaborative, which aimed to improve nutritional standards and contractually required schools to have additional nutritional standards compared to the US Department of Agriculture standards. Therefore, food choices varied throughout the schools. To address this, in all models a school's membership with the Healthy School Food Collaborative was also examined as a potential covariate, but was not a significant predictor of meal consumption and therefore was not included in the final models. It is important to note that the small number of schools in this analysis may have limited the power of the study to observe associations with the other school-level variables examined, such as the day of the week and a school's association with the Healthy School Food Collaborative. All analyses were conducted using Proc Mixed in SAS software.[35]

RESULTS

Baseline characteristics were similar across the schools; all schools had "offer versus serve" lunch and 95.9% of students were eligible for free or reduced price lunch (Table 1). In addition, all schools had high rates of minority students; 95% or more of students in all schools were African American except for school 6 (88% African American). Three foodservice vendors serviced the eight schools, and five schools were members of the Healthy School Food Collaborative. Lunch periods began between 10:45 AM to 12:55 PM across the eight schools, and the time to eat varied from 15 minutes to 40 minutes. In total, 325 students had recess before lunch and 711 students had recess after lunch.

Adjusted results from this analysis indicate that on average across the eight schools, students with recess before lunch consumed 5.1% more of their fruit than students who did not have recess before lunch (55.9% vs 50.8%; $P=0.009$; Table 2). However, there were no significant differences in lunch intake among students with recess before lunch compared to those who did not have recess before lunch for entrées, vegetables, or milk.

The timing of the lunch period was also associated with student lunch consumption. Adjusted results indicated that on average across the eight schools, students with early lunch periods consumed 5.8% less of their entrées (65.4% vs 71.2%: $P<0.001$; Table 2) and 4.5% less of their milk (52.3% vs 56.8%; $P=0.047$; Table 2) compared to students with midday lunch periods. On average, students with late lunch periods consumed 13.8% less of their entrées (57.4% vs 71.2%, $P<0.001$; Table 2) and 15.9% less of their fruit (43.5% vs 59.4%; $P<0.001$; Table 2) compared to students with midday lunch periods. There were no significant differences in vegetable intake among students with early or late lunch periods compared to those with midday lunch periods.

DISCUSSION

Adjusted results from this study found an association between reverse recess and fruit consumption, but found no significant differences in intake for entrées, vegetables, or milk. In addition, students with early lunch periods ate significantly less of their entrées and milk and students in late lunch periods consumed significantly less of their entrées and fruit compared to students with midday lunch periods. This study's unadjusted results varied considerably compared to the adjusted results (in secondary analyses, the authors examined the data stratified by grade, but found no substantial differences in the results).

Despite the national recommendations that school lunches not start before 11:00 AM, schools in this study had lunch periods that began earlier.[30] This is similar to other school districts, such as New York City public schools, that serve early lunch.[36] Data from the New York Department of Education indicate that 40% of New York City public schools (more than 650 schools) start lunch periods by 10:50 in the morning.[36] Very early or very late lunch period start times may exist for a variety of reasons. For example, crowded schools may have small cafeterias and must therefore

Table 1. Baseline characteristics of eight public schools in New Orleans, LA, participating in an 8-week plate waste study examining the association between reverse recess and the amount of food consumed by students at lunch

School	% FRL[a]	% White, non-Hispanic	% African American	% Other racial/ethnic groups[b]	% Male	Recess before lunch?
1	95.2	0.0	99.4	0.6	54.5	No
2	97	0.4	97.7	1.9	48.1	No
3	99	1.2	98.1	0.7	45.8	No
4	96.7	0.8	97.9	1.3	50.1	Yes
5	98.7	0.0	98.4	1.6	57.3	No
6	93.3	3.6	87.9	8.5	56.4	Yes/no[c]
7	96.5	1.2	94.6	4.2	46.9	Yes/no[c]
8	93.6	1.2	95	3.8	52.2	Yes

[a]FRL=free and reduced lunch.
[b]Includes Hispanic, Native American, Asian, and multiracial racial/ethnic groups.
[c]Schools 6 and 7 had a combination of recess before and after lunch. Fourth-graders had recess before lunch and fifth-graders had recess after lunch.

schedule earlier and later lunch periods in order to accommodate all students.[37] These types of logistical constraints may make potential solutions to very early or very late lunch periods difficult for schools to implement.[37] Future intervention and policy research regarding school meals should take these challenges into consideration.

Consistent with the results reported by Strohbehn and colleagues,[26] this study found that students with recess before lunch consumed more fruit than students with recess after lunch. This study's results were also similar to the studies by Tanaka and Hunsberger and their colleagues[19,27] that found no association between reverse recess and entrée and vegetable consumption; however, Hunsberger and colleagues found an association between reverse recess and milk consumption, whereas the present study did not. Unlike the results reported by Getlinger and Strohbehn,[23,26] this study found no association between reverse recess and vegetable and entrée consumption.

Table 2. Associations between reverse recess and the timing of lunch and student lunch consumption[a] (n=20,183 students) in eight public schools in New Orleans, LA, in a plate waste study to examine the association between reverse recess and the amount of food consumed by students at lunch

	Model 1[b]				Model 2[c]			
Variable	Entrée	Fruit	Vegetable	Milk	Entrée	Fruit	Vegetable	Milk
	%							
Recess after lunch	66.0 (ref[d])	53.5 (ref)	42.4 (ref)	56.0 (ref)	63.7 (ref)	50.8 (ref)	42.3 (ref)	54.9 (ref)
	mean %, β (SE[e]); P value							
Reverse recess	63.9, −2.1 (1.0); 0.04	52.7, −.8 (1.3); 0.55	44.3, 1.9 (1.4); 0.17	52.1, −3.9 (1.3); 0.002	65.6, 1.9 (1.7); 0.26	55.9, 5.1 (1.9); 0.009	44.3, 2.0 (2.1); 0.33	53.5, −1.4 (2.2); 0.54
	%							
Mid lunch period	68.4 (ref)	54.4 (ref)	42.1 (ref)	55.9 (ref)	71.2 (ref)	59.4 (ref)	42.7 (ref)	56.8 (ref)
	mean %, β (SE); P value							
Early lunch period	65.1, −3.3 (1.2); 0.004	56.0, 1.6 (1.3); 0.21	45.3, 3.2 (1.481); 0.032	52.5, −3.4 (2.1); 0.10	65.4, −5.8 (1.5); <0.001	56.9, −2.5 (1.7); 0.14	45.9, 3.2 (2.0); 0.11	52.3, −4.5 (2.3); 0.047
Late lunch period	60.1, −8.3 (1.1); <0.001	46.8, −7.6 (1.3); <0.001	41.7, −.4 (1.9); 0.84	55.3, −.6 (1.5); 0.68	57.4, −13.8 (2.0); <0.001	43.5, −15.9 (2.2); <0.001	41.5, −1.2 (3.1); 0.71	53.5, −3.3 (2.6); 0.20

[a]Results based on mixed-model regression analysis, with school as a random effect nested within conditions.
[b]Model 1 presents the unadjusted results for recess and the unadjusted results for timing of the lunch period.
[c]Model 2 presents adjusted analyses. Models examining timing of recess (reverse recess vs recess after lunch) are adjusted for student sex, grade, and timing of the lunch period. Models examining timing of lunch (mid lunch period vs early or late lunch periods) are adjusted for student sex, grade, and recess status.
[d]ref=reference value.
[e]SE=standard error.

There are several potential mechanisms that may explain the present study's lunch timing findings. Students with early lunch periods might still be full from breakfast and not yet hungry for lunch. In addition, although snacks were not part of school meal programs, students with very late lunch periods may have consumed a snack earlier in the day that reduced their hunger at lunchtime.[38]

Strengths of this study include the large number of tray observations and the examination of the timing of the lunch period. To the authors' knowledge, no other peer-reviewed studies have examined the association between the timing of the lunch period and the amount of food consumed by students at lunch.

This study has several limitations. First, the cross-sectional design of this study did not allow for a determination of change in consumption if the timing of the lunch period or recess was changed; thus, results from this analysis are preliminary and additional research is warranted. Second, the study population did not have socioeconomic and demographic characteristics that were similar to the national average, which limits the generalizability of the study's findings. However, these study results are likely generalizable to other low-income, urban school districts. Third, the present study did not have information on the exact amount of seated time each student had to eat his or her lunch nor student behavior in the cafeteria, which might impact overall consumption.[39] However, overall there were no substantial differences in average lunch period lengths between schools that had recess before lunch compared to schools that had post-lunch recess. Future research should examine the amount of seated time students have to eat in the cafeteria, as well as their behavior in the cafeteria and the impact of reverse recess and the timing of the lunch period. In addition, during the study's data collection period, instructing students not to share or trade food may have added to the intrusiveness of the study's measures and impacted consumption. Lastly, because this study only examined lunch consumption among students who purchased their lunch from school, the findings cannot be generalized to students who bring their lunch from home. Future studies should examine the impact of timing of the lunch period and reverse recess on "brown bag" lunch consumption in schools. In addition, future research should examine the association between the timing of the lunch period and student lunch consumption among middle and high school students. Future studies should also examine whether water availability in cafeterias impacts the association between reverse recess, the timing of the lunch period, and student lunch consumption.

Lastly, while some of the differences observed in the average daily consumption were small (eg, consuming 4.5% less milk at the early lunch period translates to a difference of approximately 0.36 oz consumed of an 8-oz serving of milk), many public health interventions are based on the premise that small changes in behavior over time can yield improvements in health.[40] If students consume more of their school lunch, even in modest amounts, over time this may result in better nourishment and health. Future research should examine the long-term impacts of school-based nutrition interventions and policies, such as reverse recess and the timing of the lunch period. In addition, the magnitude of our associations for entrée and fruit consumption for students with late lunch periods are similar to the magnitude of the findings for the Hunsberger, Getlinger, and Bergman studies.[19,23,24]

CONCLUSIONS

This study found that reverse recess was associated with increased fruit consumption, but found no association between reverse recess and entrée, vegetable, or milk consumption. In addition, when compared to more traditional, midday lunch hours (in which lunch period start times ranged from 11:55 AM to 12:15 PM), early lunch periods were associated with decreased entrée and milk consumption and late lunch periods were associated with decreased entrée and fruit consumption. However, before schools consider modifications to their lunch policies to reduce food waste, additional research on recess status and the timing of lunch periods is warranted. Schools should ensure changes lead to nutritionally meaningful results before implementing school lunch policy changes. Future research should examine both the short-term and long-term impacts of the timing of the lunch period and school lunch consumption among older children and in other diverse school settings.

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