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Eat Lunch First or Play First? Inconsistent Associations with Fruit and Vegetable Consumption in Elementary School

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ABSTRACT
Scheduling play before eating lunch has been suggested as a relatively simple environmental strategy to increase fruit and vegetable (FV) intake among elementary school students. However, the few small studies to date have had mixed findings. The primary aim of this observational study was to evaluate the possible relationship between the relative order of play and eating and students' lunch intake of FV. A secondary aim was to examine whether any differences existed in this relationship by student sex, ethnicity, language spoken at home, and school lunch source. A diary-assisted 24-hour recall was collected during the 2011-2012 school year from 2,167 fourth- and fifth-graders attending 31 elementary schools in California. The association of play before eating with FV intake was estimated using Generalized Estimation Equations. Overall, lunch FV intake was not significantly higher for students who had a play-before-eating vs a play-after-eating lunch schedule at school. However, variables included in the model showed significant interaction with play before eating, resulting in the need for separate effect estimates for distinct strata based on sex, ethnicity, language spoken at home, and school lunch source. For 10 of the 16 strata, no significant effect of play before eating was observed on lunch FV intake, while increases in intake were observed in four strata and decreases in two strata. Before rescheduling play before eating for the purpose of improving student FV intake, additional research is recommended.
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FRUIT AND VEGETABLE (FV) INTAKES ARE INADEQUATE in the United States. In 1999-2002, US children 6 to 11 years old consumed <2 cups FV per day; a majority (74.1% for fruit, 83.8% for vegetables) did not consume recommended amounts.[1] There is evidence that low socioeconomic status has a negative impact on FV intakes.[1-3] The health benefits associated with consuming more FV[4] and the tracking of dietary behaviors into adulthood[5,6] are reasons to increase FV intakes among youth. Most FV interventions targeting children have been school-based, resulting in modest increases in FV intake on the order of 1/6 to 1/2 cup/day.[7] While multifactorial interventions of at least 1 year in duration that include students, staff, and parents as well as the school food environment have shown the most promise, they also require substantial resources.[7,8] Relatively simple, inexpensive, and sustainable environmental school strategies are needed to increase student FV intake.

One potential strategy involves reordering the timing of play and eating during the lunch period.[9] While in 2000, only 5% of US elementary schools scheduled play before eating lunch for all students,[10] many states have recently recommended this practice, and one state requires that elementary schools serve lunch after playtime.[11] It has been hypothesized that students who are physically active before eating lunch may consume more because they are hungrier after playing, are less concerned about the discomfort of playing with a full stomach, or have more time to eat, as lunch lines may be reduced and students are not in such a hurry to get to the playground.[12-14] Findings to date have been mixed when schools have switched from play after to play before eating lunch, variously showing an increase in FV intake,[12,15] no change in FV intake,[14,16] or a decrease in FV intake.[17] However, studies have generally been short-term (measures taken days after a schedule change), involved few schools (only one), not included a control group, and not examined whether impacts vary according to student characteristics.

The primary aim of the current study was to evaluate the relationship between the timing of play (before vs after eating lunch) and the intake of FV at school, using baseline data from an intervention trial. A secondary aim was to examine whether any differences existed in the relationship between order of play and eating time, with FV intake by student sex, ethnicity, language spoken at home, and school lunch source (purchased at school or brought from home).

METHODS

Study Design

Data were collected in 2011-2012 as part of a cluster randomized controlled trial to evaluate the effectiveness of the

California Children's Power Play! Campaign, a school-based educational intervention to promote FV intake and physical activity among fourth- and fifth-grade children in low-resource elementary schools in California (A. Keihner and colleagues, unpublished data, 2014). No changes were made to the school cafeteria or lunch schedule. Inclusion and exclusion criteria were developed, with the goal of obtaining a sample of elementary schools with a diverse student body that would be similar to other low-resource public schools in California. Schools were omitted from recruitment based on the following: not having fourth- or fifth-grade classes; having <30 students per grade; having received the planned or similar intervention in the year prior; district saturated with other wellness activities; district refusal to participate; and having characteristics (location bordering Mexico, being a juvenile detention school) that could limit generalizability of findings. For inclusion, schools needed to have ≥50% of the student body qualify for free and reduced-price school meals. From an initial list of 221 elementary schools in San Diego and Imperial counties, the 131 eligible for participation were contacted by e-mail, phone, and a mailed letter to each principal. In some instances, study staff visited the school to meet the principal. The first 45 schools that agreed to participate were included in the study. The intervention study was reviewed and approved by the Institutional Review Board of the Public Health Institute; the present study was deemed exempt by the Committee for the Protection of Human Subjects at the University of California, Berkeley.

Baseline data were collected from students at 45 elementary schools. All fourth- and fifth-grade students in each school were eligible to participate, except in one exceptionally large school, where 6 of 14 fourth- and fifth-grade classrooms were randomly selected to participate. Subsequently, 1 school discontinued participation due to a fire, leaving 44 schools from six school districts. For this analysis, 13 schools were excluded because dietary information was collected on a minimum day. Minimum days do not follow the standard play and eating time structure and, therefore, result in an undefined exposure of interest. The final analytic sample consisted of baseline data collected from 2,167 children in 31 schools from four school districts.

Data Collection

The exposure of interest, the order of play and eating during the lunch period, was determined by querying school foodservice staff. School foodservice staff at each school were asked the following question, with the response recorded by research staff on an environmental inventory tool: For the fourth- and fifth-graders, is their play time before or after they eat lunch? The outcome of interest, student FV intake during school lunch, was computed using a 24-hour diary-assisted recall conducted on a school day and information on school foods collected by interviewing school foodservice staff, as described previously.[18] Student demographic data (sex, ethnicity, language spoken at home) were obtained by student survey. The survey was completed in the classroom with guidance from research staff. Students participated in a training session on how to record their food intake. Methods of recording what, when, and how much was eaten were emphasized. Each child received a set of measuring cups and spoons for portion size measurement. Within 2 days of completing the food diary, a trained dietary interviewer conducted a recall interview individually with each child using the multiple-pass method.[19] Food models were used to clarify portion sizes and details on forgotten foods were elicited. Foods were coded using the US Department of Agriculture Food and Nutrient Database for Dietary Studies.[20]

Data Analysis

First, a definition of the outcome of FV consumed at lunch was chosen. For each food or beverage consumed over 24 hours, students reported eating occasion (breakfast, lunch, dinner, or snack), time of day, and location obtained and eaten (home, school, friend's home, fast-food or pizza restaurant, other restaurant, or other). To account for errors in estimation of school lunch times by students, while allowing for the possibility that students took lunch items from the cafeteria to eat during recess or class time, we used the following criteria to define our outcome, lunch FV intake at school: any item reported as lunch and as eaten at school within 15 minutes of the school lunch period.

Second, a range of summary statistics was calculated. Student- and school-level characteristics were compared using appropriate tests (χ^2 test for independence, clustered t test, t test) to determine whether characteristics differed (unadjusted for any covariates) between play-before-eating vs play-after-eating groups.

Third, estimation of the association of play before eating on lunch FV intake was performed using Generalized Estimating Equations (GEE) with clustering at the school level.[21] The package *geepack* available in the statistical software R[22] was used.[23] Due to clustering at the school level, as well as apparent nonconstant variance, inference was obtained with robust standard errors using the Huber-White (Sandwich) estimator. Based on α=.05, a power level of 0.8, and the study sample size, we would be able to detect a difference of ≥1/6 cup FV.

Fourth, variable selection modeling, including identification of possible interaction terms associated with each group (play before vs after eating lunch), was carried out in two stages. The candidate variables included were originally selected based on subject matter expertise. We did not adjust for calorie intake, as our outcome of interest was FV intake, regardless of whether differences in FV intake were related to differences in calorie intake. Adjusting for calorie intake (ie, holding calories constant) would have addressed a different outcome relating to whether FV replaced other sources of calorie intake under our setting of interest. Initially, association of play before eating with student-level characteristics (reported ethnicity, age, sex, spoken language, and whether school lunch items were eaten) was assessed by analysis of variance for a range of nested GEE models. Second, association of FV consumption with the same variables, as well as play before eating, was assessed by sixfold cross validation using mean squared error loss (MSE) for a series of GEE models.[24] In the cross-validation procedure, the data were randomly split into six groups containing equal numbers of schools. Then the MSE for each group was obtained using a model fit on the other groups, after which the six MSE values were averaged. The entire process was repeated 100 times for each set of variables to obtain a more stable average. Models included the following: 1) only the exposure of interest, play

before eating; 2) the exposure of interest with indicators for male sex, ethnicity, language spoken in the home (English, any Spanish, other), and whether items consumed at lunch included food from school (as opposed to food brought only from home or elsewhere); 3) all terms in 2) with added interaction terms between the exposure and other listed variables. From these different models, the one that had the lowest average cross-validated MSE was chosen as the best model to predict FV consumption. The variables included in the final model to estimate association of play before eating with FV consumption are those that were included in either the model predicting play-before status or the model predicting FV consumption.

RESULTS AND DISCUSSION

The study sample was comprised of 281 students (from six schools) with play scheduled before eating lunch, and 1,886

Table 1. Demographic and dietary characteristics in a sample of fourth- and fifth-grade students from 31 low-resource public elementary schools in four school districts in Southern California with a play-before-eating or play-after-eating lunch schedule

	Total sample (N=2,167)	Play before eating (n=281)	Play after eating (n=1,886)	*P* value[a]
	←——— *%* ———→			
Sex, male	48.2	40.2	49.5	0.024
Fourth grade	49.6	44.1	50.4	0.214
Race/ethnicity				
Hispanic	47.2	38.8	48.5	0.015
Non-Hispanic	35.2	42.4	34.2	0.027
White	14.7	19.8	14.0	0.073
African American	9.3	14.7	8.5	0.010
Asian	7.7	3.2	8.3	0.023
Native American or Alaskan Native	1.7	1.8	1.7	1.000
Pacific Islander or Native Hawaiian	1.8	2.9	1.7	0.464
Other[b]	17.4	18.7	17.3	0.831
Language spoken at home[c]				
English only	52.7	66.9	50.5	<0.001
Spanish	38.1	26.3	39.9	<0.001
Other	9.2	6.8	9.6	0.357
Eating from school lunch[d]				
School item(s) eaten	62.1	64.1	61.8	0.691
	←——— *mean±standard deviation* ———→			
Fruit and vegetable intake (cups)				
Total daily fruit and vegetables	1.90±1.47	1.98±1.46	1.89±1.47	0.691
Total daily fruit	1.11±1.13	1.14±1.22	1.10±1.11	0.887
Total daily vegetables	0.80±0.83	0.85±0.81	0.79±0.83	0.691
Fruit and vegetables at lunch	0.49±0.71	0.57±0.76	0.48±0.70	0.357
Fruit at lunch	0.29±0.58	0.33±0.63	0.29±0.57	0.566
Vegetables at lunch	0.19±0.39	0.23±0.43	0.19±0.39	0.357
Energy intake (kcal)				
Total daily	1,707±719.2	1,787±716.4	1,695±733.6	0.468
At lunch	448±356.6	494±399.2	442±350.6	0.357

[a]Student at schools with play before vs after eating compared by χ^2 test for independence with Yates' continuity correction. Consumption values compared with clustered *t* test. *P* values are adjusted with those in Table 2 by Benjamini and Hochberg's method to control false discovery rate.

[b]Students were able to choose the category "Other" as an option for ethnicity. Numbers may not add up to 100% because of rounding.

[c]Students were asked what language they usually spoke with adults at home, with the following response options: English, Spanish, Spanish and English, or Other. Responses for Spanish and Spanish and English were combined, as very few (approximately 9%) students reported Spanish only.

[d]All students ate lunch at school on the day of the survey, but some ate the lunch provided by the school and others brought lunch from home or some other place. Students were included as eating from the school lunch if at least one item (food or beverage) consumed at lunch was sourced from the school.

students (from 26 schools; 1 school had both lunch structures for different classes) with play after eating (Table 1). Compared to schools with play after eating, schools with play before eating included fewer boys, fewer Hispanics and Asians and more African Americans, and more English-only–speaking families. Most schools included grades kindergarten through five, but the play-after-eating group also had one kindergarten-through-grade-four, five kindergarten-through-grade-six, and three kindergarten-through-grade-eight schools. Other school characteristics that might impact student FV intake did not differ significantly between schools with play-before-eating vs play-after-eating schedules (Table 2). Dietary intake was not recorded under conditions of identical menus. However, based on the fact that all schools had salad bars and a similar proportion of schools in each group offered an entrée with vegetables on the day that students recorded in their food diaries, differences in the amounts of FV available at schools by group is not likely to have influenced our findings.

Because students were allowed to define what they considered to be "lunch," items were reported as lunch at times throughout the day. For example, 19.3% of items reported as lunch were not consumed within 15 minutes of the school lunch period. Of the items not consumed within 15 minutes of the school lunch period, 34.7% were reported before our lunch window of time (between 6 AM to 15 minutes before lunch) and 65.2% of them were reported during times after our lunch window (15 minutes after lunch to 5:59 AM). We are unable to determine whether students were misreporting times or saving items from lunch and eating them afterward.

In comparing students who had play before vs after lunch, unadjusted for student characteristics, there were not significant differences in intake of FV daily or at lunchtime. We next examined lunch FV in adjusted models. The model chosen by the criteria described in the data analysis section above is summarized in Table 3. The model for FV intake included variables for sex, Hispanic ethnicity, whether Spanish was spoken in the home, and whether a school lunch item was eaten. All variables selected for inclusion in the model showed significant effect modification with play before eating, meaning that the relationship between play before eating and FV intake was not a simple one, but varied depending on the factors that were included in the model, that is, the characteristics of the students. The adjusted estimate for play before eating (0.349 cup FV at lunch; $P<0.001$) is interpreted as the expected average effect for children who do not have any of the characteristics where we see interactions: non-Hispanic girls who speak only English at home and did not eat any lunch items obtained at school. Although a 1/3-cup greater consumption of FV is modest relative to recommended intakes, this amount is similar to what is typically achieved by FV interventions, which often include multiple components extending beyond the school environment and, if translatable to large populations, could have important long-term impacts on chronic disease.[7]

Table 2. Characteristics of the food environment for 31 low-resource public elementary schools in four school districts in Southern California with a play-before-eating or play-after-eating lunch schedule

	Total sample (N=31)	Play before eating (n=6)[a]	Play after eating (n=26)[a]	*P* value[b]
	←——— *mean±standard deviation* ———→			
Total student enrollment	403.9±165.2	383.2±214.9	403.6±155.3	0.635
Total eligible for free/reduced lunch (%)	73.5±13.1	64.8±13.0	75.5±12.5	0.237
Length of lunch period (min)	38.8±6.8	38.3±5.2	38.9±7.1	0.963
Length of eating time during lunch period (min)	22.3±8.8	20.8±4.9	22.6±9.3	0.691
Time from start of school to start of lunch period (h)	3.94±0.52	4.10±0.21	3.93±0.55	0.357
Time to eat after last student in line served (min)	18.6±10.3	13.7±6.2	19.4±10.8	0.329
	←——— % ———→			
School personnel in lunch line encouraging students to eat fruit/vegetables[c]	38.7	33.3	51.6	1.000
School personnel at lunch tables encouraging students to eat fruit/vegetables[c]	9.7	16.7	11.5	1.000
Salad bar in cafeteria	100	100	100	—
À la carte offerings in cafeteria	0	0	0	—
Served lunch entrée with vegetables on day that students recorded in food diary	48	50	46	1.000

[a]One school had classes in both groups and is therefore counted in both the play-before-eating and play-after-eating groups. Analysis repeated with the school omitted did not show any significant differences.

[b]Schools with play before vs after eating compared by Fisher's exact test for categorical variables and *t*-test for continuous variables. *P* values are adjusted with those in Table 1 by Benjamini and Hochberg's method to control false discovery rate.

[c]Whether school personnel were encouraging students to eat fruit/vegetables was evaluated by a trained observer during the school lunch period.

Table 3. Predictors of fruit and vegetable consumption at lunch in a sample of fourth- and fifth-grade students (n=2,167) from 31 low-resource public elementary schools in four school districts in Southern California

	Cups of Fruit and Vegetables Consumed at Lunch		
Predictors	**Estimate[a]**	**Standard error**	***P* value**
Independent variables and effect modifiers			
Reference	0.398	0.042	<0.001
Play before eating at school (PB)	0.349	0.074	<0.001
Boy (B)	−0.031	0.032	0.328
Student ate item from school lunch (SL)	0.123	0.051	0.017
Spanish spoken in home (SS)	0.168	0.074	0.023
Hispanic ethnicity (H)	−0.127	0.056	0.023
Interaction terms[b]			
PB:B	−0.205	0.051	<0.001
PB:SL	−0.218	0.071	0.002
PB:SS	0.390	0.138	0.005
PB:H	−0.365	0.095	<0.001
SL:H	0.216	0.067	0.001
SL:SS	−0.209	0.097	0.031

[a]Values in this column are coefficients in the model to estimate fruit and vegetable consumption based on student characteristics. For example, the estimate of 0.398 cups (reference row) represents the average lunchtime intake of fruit and vegetables for students who do not have any of the characteristics that are included in the model (ie, girl at a play-after-eating school who did not eat anything from the school lunch, does not speak Spanish at home, and is not Hispanic). Students who have all the same characteristics as the reference group, except that they are at a play-before-eating school, had a significantly higher lunchtime fruit and vegetable intake of 0.398+0.349 or 0.747 cups. A boy similar to the reference group, but at a play-before-eating school would have a 0.398+0.349−0.205 or 0.542 cups (a difference that was not significant from the reference group).

[b]Interaction terms use the abbreviated terms contained in parentheses next to the coefficients.

Due to finding significant interactions, estimated effects and their 95% CIs by the 16 strata according to sex (boy or girl), ethnicity (Hispanic or non-Hispanic), language usually spoken at home (any Spanish spoken or not), and source of school lunch (any obtained from school or not) are provided in Table 4. These are based on linear combinations of coefficients and their standard errors from the model presented in Table 3. For 10 of 16 strata, no significant association of play before eating with lunch FV intake was found. Four strata had significantly higher FV intakes at lunch when play was before vs after eating: 1) non-Hispanic boys who spoke Spanish at home and brought lunch from home or elsewhere; 2) Hispanic girls who spoke Spanish at home and brought lunch from home or elsewhere; 3) non-Hispanic girls who spoke Spanish at home and brought lunch from home or elsewhere; and 4) non-Hispanic girls who did not speak Spanish at home and brought lunch from home or elsewhere. In contrast, two strata had lower FV intake at lunch when play was before vs after eating at lunchtime: Hispanic boys and girls who did not speak Spanish at home and ate the school lunch. Therefore, when a significant association was found, play before eating had a positive association with FV intake among fourth- and fifth-grade students who only brought lunch from home or elsewhere (ie, did not purchase any foods or beverages from the school); play before eating had a negative association with FV intake when any lunch items were obtained from school, but only among Hispanic students. In our sample, 21.9% of students only ate items from home, 20.6% reported eating both home and school items, and 57.5% ate only school items. We do not know whether students who brought lunch from home brought more or less FV than what was provided through the school lunch. All schools in the sample had a salad bar and students served themselves FV; amounts were not prescribed. However, we compared total and lunch FV consumption based on whether students ate an item from school or only items from home and found no significant difference in FV consumption. It is unclear why a play-before-eating schedule might differentially impact students' FV intake depending on lunch source. Students bringing lunch from home have been shown to have more time to eat, as they do not need to wait in the lunch line.[25] However, one study has shown that a play-before-eating schedule results in reduced average time students spent in the lunch line, as children trickle into the cafeteria from the playground rather than entering at the same time.[14] We found no difference between play-before-eating vs play-after-eating schools in the time available that the last student in line had to eat. However, we did not measure average time for students waiting in line or available to eat. Additional investigation of possible differential impacts on student intakes depending on lunch source is warranted.

We are aware of one other observational study comparing schools with and without play before eating; however, this study did not quantify FV intake. Bergman and colleagues compared plate waste in grades three to five in one school per group.[13] The school with play before eating had

Table 4. Point estimates and 95% CIs for effect of play before eating lunch for all combinations of effect modification in a sample of fourth- and fifth-grade students (n=2,167) from 31 low-resource public elementary schools in four school districts in Southern California[a]

Sex	Ethnicity	Spanish spoken at home[b]	School lunch eaten[c]	Sample size	Cups of Fruit and Vegetables Consumed at Lunch	
					Estimated difference[d]	95% CI
Male	Hispanic	Yes	Yes	239	−0.049	−0.364 to 0.267
			No	104	0.170	−0.047 to 0.386
		No	Yes	82	−0.438	−0.611 to −0.266***
			No	44	−0.220	−0.474 to 0.034
	Non-Hispanic	Yes	Yes	19	0.316	−0.181 to 0.814
			No	20	0.534	0.128 to 0.941**
		No	Yes	230	−0.074	−0.219 to 0.073
			No	308	0.145	−0.017 to 0.306
Female	Hispanic	Yes	Yes	264	0.156	−0.245 to 0.557
			No	126	0.374	0.079 to 0.670*
		No	Yes	95	−0.234	−0.446 to −0.021*
			No	65	−0.015	−0.259 to 0.228
	Non-Hispanic	Yes	Yes	35	0.521	−0.052 to 1.093
			No	19	0.739	0.265 to 1.213***
		No	Yes	303	0.131	−0.105 to 0.367
			No	214	0.349	0.149 to 0.550***

[a]Model used is that presented in Table 3.
[b]"Yes" means that Spanish or Spanish and English were spoken with adults at home.
[c]"Yes" means at least one item eaten at lunch was obtained from the school lunch.
[d]Values in this column represent the estimated difference in lunchtime fruit and vegetable consumption (in units of cups) for a student having the indicated characteristics in a play-before-eating vs play-after-eating school. A negative number signifies that a student having all the indicated characteristics at a play-before-eating school had a lower fruit and vegetable intake than a similar student at a play-after-eating school; a positive number signifies that a student having all the indicated characteristics at a play-before-eating school had a higher fruit and vegetable intake than a similar student at a play-after-eating school.
*$P<0.05$.
**$P<0.01$.
***$P<0.001$.

significantly less overall plate waste (27.2%) compared to the school with play after eating (40.1%). However, no statistical adjustment was made for student characteristics that may have differed between schools or for clustering by school. We did not measure plate waste at lunch, but did not observe any differences between play-before-eating vs play-after-lunch groups in self-reported intakes of calories at lunch or daily.

Prior intervention studies, all using plate waste methods, have found mixed impacts of play before eating on student intakes. None used a randomized controlled design. In a pre–post study in one school involving 90 children, students in grades one to three who continued on an eat-before-play schedule were compared to students in grades one to two who switched to a play-before-eat schedule.[15] Less plate waste (by 25% for vegetables, 36% for salad, 54% for fruit) was recorded immediately after the schedule change in the play-before-eating vs play-after-eating group, but statistical tests were not reported. Another pre–post study in one school (no control group) involving 67 students in grades one to three found that 3 weeks after switching to a play-before-eating schedule, overall plate waste significantly decreased.[12] FV intake increased significantly in the total sample and for boys; for girls there were no significant pre-post changes in FV intake.

In contrast to these findings, in a pre–post study in one school (no control group) involving approximately 80 students in grade six, no significant changes in plate waste overall or for FV were found after switching to a play-before-eating schedule.[14] Another study involving 980 students at three schools (two with grades kindergarten through grade 2 and one with grades five through eight; no control group) also did not find significant pre–post changes in food or beverage waste after switching to a play-before-eating schedule.[16] Strengths included keeping plate-waste measures unannounced to students, measuring lunches brought from home (other studies did not address whether lunches from home were included), and long-term follow-up (1 year after play before eating was implemented). Interestingly, much of the initial decrease in food waste observed from baseline to first follow-up several months later disappeared at the 1-year time point, suggesting that any immediate effect may diminish as students adjust to a new schedule. Lastly, a pre–post comparison conducted in one school (no control) found that plate waste increased overall and for FV when lunch was switched to a play-before-eating schedule.[17] Rigorously conducted randomized controlled trials with adequate time for exposure to a lunch schedule change are

needed to better isolate lunch scheduling as the only factor impacting student intakes.

Strengths and Limitations

Strengths of this study include the large number of schools and ethnically diverse students in the sample, use of a diary-assisted 24-hour recall to assess dietary intake, assessment of other school characteristics that might impact student FV intake, and examination of the established effect of timing of play and eating time rather than a short-term impact as most prior studies. The diary-assisted 24-hour recall is a blending of two dietary assessment methods that maximizes the strengths of both the food record and the 24-hour recall. The dietary record method has the potential for providing more accurate information by recording foods as they are consumed and the 24-hour recall is the method used in the only nationally representative dietary survey in the United States.[26] This study is not without limitations, however. It is observational in nature and was not designed specifically to test the association of play before eating with student intakes. A relatively small number of schools (19% of the study sample) and students (13% of the study sample) were in the play-before-eating group, and all data were collected from schools in a single geographic region of southern California; therefore, results may not be generalizable to other schools. However, to our knowledge, this is the largest study to date of play and lunch schedules in relation to student dietary intake. Although the most reliable method was used to collect self-reported dietary intake data in a population-based sample, self-report is less accurate than methods involving direct measurement,[27] such as the plate-waste measures used by prior studies. Dietary intakes are based on only 1 day of recall per child. Further, we did not standardize menus across schools and did not quantify the quality or amounts of FV available to students in lunches provided by school or brought from home. It may be that the effect of play before eating is not observed for some individuals due to these or other unmeasured factors. It should be noted that this study was conducted before enactment of the Healthy, Hunger-Free Kids Act, which requires that students eating the school lunch take a fruit or vegetable. It is possible that the impacts of the order of play and eating time may differ when students are required to have FV on their plate. Finally, we examined only FV intake as an outcome; scheduling play before eating time at school lunch may have other impacts, such as improvements in student behavior.[14]

CONCLUSIONS

Although there was not consistent evidence of a difference in FV intakes at lunch associated with play before eating across the entire sample, effects may occur within particular groups, for example, girls and/or those who bring lunch from home. Before schools consider lunch time policy changes for the purpose of improving student FV intake, however, additional research is recommended to better understand the impact of the order of play and eating time during the lunch period on student dietary intakes.

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