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Food Defense Best Practices Reported by Public School Food Authorities in Seven Northern U.S. States

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Abstract
Purpose/Objectives This study reported food defense planning, training and best practices implemented in public schools in Montana, Wyoming, South Dakota, North Dakota, Iowa, Minnesota, and Wisconsin. Methods An internet-administered survey was sent to 1,501 school food authorities or food service directors (FSDs) in public schools. Survey items included frequency of implementation of 31 food defense best practices adapted from the work of Yoon and Shanklin (2007) and Yoon (2007). Focus was on practices relating to employee management, utility security, facility security, and communication. Additional items requested information about food defense planning, food defense training, operational, and demographic characteristics. Results Response rate was 36% (543 usable responses). Most (67.2%) survey respondents reported district enrollment < 2,500 students. The majority reported onsite (54.3%) or combination onsite/commissary (33.0%) food production systems. Few (14.5%) had a food defense plan and 21.6% reported some food defense training. Of the 31 listed practices, 16 practices had mean frequencies of implementation between most of the time and always (M > 4.0 on a 5-point scale with 5 = always). Of these, 13 practices were the responsibility of the foodservice operation, such as inspecting food packages, restricting access to food storage and production areas, training employees about safe chemical use, monitoring food production areas, securing outside entrances and storage units, restricting access to central utility controls, and having procedures to follow if utilities were compromised. Six practices (19.4%) were implemented less than some of the time (M < 3.0): doing criminal background checks on employees periodically after hire, implementing a policy that all delivery trucks be locked when unattended, communicating with emergency responders about food defense and food safety, communicating with administrators about food defense, and monitoring drains and water lines for tampering. Application to Child Nutrition Professionals Food defense practices under the control of the foodservice operation had high rates of implementation. Practices that overlapped with district control, such as monitoring drains and water lines or doing criminal background checks on current employees, had low reported frequencies of implementation. There is a need to involve district administrators in food defense planning.

Keywords
food defense, food safety, school administration, emergency response

Disciplines
Educational Assessment, Evaluation, and Research | Growth and Development | Industrial Organization | Nutrition

Comments
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Impacts of Scheduling Recess Before Lunch in Elementary Schools: A Case Study Approach of Plate Waste and Perceived Behaviors

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ABSTRACT

Purpose/Objectives
Recess Before Lunch (RBL) for elementary students is considered a best practice related to increased nutrient intakes at lunch, decreased afternoon behavioral issues, and increased afternoon learning efficiency; however, school characteristics, such as amount of time for lunch, offer vs. serve, and scheduling factors can influence implementation. A qualitative study to examine impacts of RBL on plate waste and school stakeholders' perceptions of third grade students' behaviors in three school districts in one Midwest state was conducted. The results were used to develop a guide that includes tools and best practices to assist schools in determination of recess scheduling.

Methods
Digital photography and weight-based assessment of plate waste by meal component were collected among third-graders in three geographically distinct, independent school districts with varying student enrollments. Data were collected on two occasions in fall when recess was scheduled after lunch and again in spring when recess was scheduled before lunch. Following completion of a short survey, interviews with multiple stakeholders at each school building were conducted in fall and spring to assess views of the benefits and challenges associated with changing to recess before lunch.

Results
Plate waste and fluid milk consumption varied between sites. Findings suggest other environmental influences affect food and milk consumption beyond scheduling of recess. Digital photography method of plate waste estimation was validated with comparisons to actual weights and measures.

Application to Child Nutrition Professionals
Findings from this study were utilized to develop a guide to assist decision makers considering moving recess before lunch. The guide includes tools and best practices to assist schools in the determination of making the change to recess before lunch. The guide is located on the USDA State Sharing Center webpage and available as a resource to all interested parties.

Keywords: recess; schedule; plate waste; school lunch

INTRODUCTION

At present, more than 30% of school-aged children are either overweight (defined as BMI [body mass index] ≥85 – 94%) or obese (≥95% on growth charts) (Ogden, Carroll, Kit, & Flegal, 2014). Though causality remains elusive, obesity in children is associated with numerous comorbidities (Dietz, 1998). These include glucose intolerance and type 2 diabetes (Weiss & Kaufman, 2008), obstructive sleep apnea (Arens & Muzumdar,1985), hypertension (Sorof & Daniels, 2002), depression (Blaine, 2008), and asthma (Permaul, Kanchongkittiphon, & Phipatanakul, 2014). These conditions lead to social and economic costs with expenses of increased health care and potential decline in learning due to social and psychological issues. Childhood obesity is a strong predictor of adult obesity (Ogden et al., 2014). Thus, from health, academic, and budgetary perspectives, it is important to combat childhood obesity.

Policy efforts have aimed to reform "calories in" portion of the energy balance equation. Based on recommendations from the Institute of Medicine and the National Academy of Sciences, changes were made to the National School Lunch and School Breakfast Programs (NSLP and SBP, respectively) to align with 2010 Dietary Guidelines for Americans. These changes were included in the 2010 Child Nutrition Reauthorization Act, or Healthy, Hunger Free Kids Act (HHFKA), effective July 2012. The HHFKA requires reimbursable school lunch meals to include one full serving each of a fruit and vegetable. For schools using offer versus serve, students must select a ½ cup serving of either a fruit or vegetable as part of the reimbursable meal. A NSLP plate waste study of Los Angeles middle school students conducted prior to 2012 found approximately 22% of fruits and 31% of vegetables served were wasted (Gase, McCarthy, Robles, & Kuo, 2014). In 2010, Boston middle school students consumed 60% of all foods served, but 19% entrees, 47% fruit, 73% vegetables, and 25% milk served were wasted; no differences were found between gender of students (Cohen, Richardson, Austin, Econumus, & Rimm, 2013).

Following changes to NSLP, limited data has been published on waste in school meals. While one study found new requirements increased fruit consumption and did not increase total plate waste (Schwartz, Henderson, Read, Danna, & Ickovics, 2015), anecdotal plate waste analysis by nutrition program directors suggested children were not increasing fruit/vegetable intake, and the changes increased costs (School Nutrition Association, 2014). Studies have documented increased waste but focused on fruits and vegetables rather than the entire meal, or collected data at few locations, or for limited duration. This study occurred after implementation of the new NSLP requirements in the 2012 academic year. Because determining actual weights or amounts of foods consumed is time consuming and disruptive, alternative plate waste assessment methods such as digital photographs of trays at service and return have been used. These methods have been shown to be accurate and cost-effective (Kirks & Wolff, 1985; Swanson, 2008).

Environmental factors may influence consumption, including amount of time children have to eat, time of day lunch is served, items served, and placement of recess in relation to the lunch period. In a study examining recess placement, Getlinger et al. (1996) reported plate waste decreased from 34.9% to 24.3% when recess was before lunch for grades 1-3; similar studies have demonstrated comparable results (Read & Moosburner, 1985; Smith, 1980). However, other researchers (Hunsberger, McGinnis, Smith, Beamer, & O'Malley, 2014; Tanaka, Richards, Takeuchi, Otani, & Maddock, 2005) found recess scheduling did not significantly affect food

consumption; rather it impacted milk waste. Different approaches to plate waste collection and measurement were used in these studies, which may explain variations in specific findings. Further, administrators have a myriad of factors to consider when scheduling recess: teacher and monitor schedules, availability and access of areas, transition times, restroom locations, winter weather gear, hand washing, and cafeteria service schedules (Bark, Stenberg, Sutherland, & Hayes, 2014; Bounds, Nettles, & Johnson, 2009; Rainville, Wolf, & Carr, 2006).

Based on data collected in different states, recess before lunch (RBL) is considered best practice for its purported ability to decrease plate waste, increase consumption of school lunch, and calm lunchroom and afternoon classroom environments. However, data has been collected in specific states using various methods; thus findings may not be generalizable to all. This research utilized a rigorous qualitative approach in assessing plate waste and recess scheduling perceptions and impacts. The first aim was to assess validity of photography-based estimations of plate waste with actual weights and measures in NSLP plate waste by meal component among one grade level from three different school districts. The second aim was to quantify amount of plate waste with RBL and recess after lunch (RAL). The third aim was to assess perceptions from multiple stakeholders within each school setting regarding benefits and challenges to RBL.

METHODS

Sample

A convenience sample of three districts in one Midwestern state was selected to ensure variations in district enrollment (1,288, 4,700, and 9,486 students) and willingness to change recess schedule mid-year. Third grade was selected because this is an age of active growth and behavior changes (Hughes & Bryan, 2003). Districts agreed to allow staff time for completion of short questionnaires and interviews as well as provide space in school cafeterias for plate waste collection. Interviewees included lunch room and recess monitors, third grade classroom teachers, school nurses, and building administrators. An incentive of $1,500 for milk storage and recess equipment was offered by the regional Dairy Council.

Data Collection

A quasi pre-post experimental design format was used with recess schedule serving as intervention. Project protocol were reviewed and approved by Institutional Review Board. Two site visits were made to each of the three districts in fall (RAL), and two visits in spring (RBL). Interviews with selected stakeholders were conducted at the first visit RAL and RBL.

Plate waste assessments and photo estimations were conducted at all site visits (N=12). At least six weeks elapsed between visits. At each site, the same entree menu item was served for all consecutive visits; however, there were variations of side options, such as fruit or vegetable offerings. Similar menu items were featured at each school (i.e. entrée on bun) to control for menu popularity. One district offered two entrée choices in addition to the entrée on a bun.
Questionnaires and Interviews. A short questionnaire (multiple choice and short answer) was sent to designated staff prior to the first visit (n = 7 or 8 at each school) A structured interview guide was used to conduct a total of 21 interviews at schools on the first site visit in fall and 17 interviews in the spring with most of the same individuals. Field notes about school and foodservice program policies and procedures were taken, such as style of service (i.e. offer

versus serve), location of hand washing facilities, storage of winter weather gear, and traffic flow patterns.

Plate Waste. An in-service training for all members of the research team and student assistants was conducted to establish inter-rater reliability in assessments of waste in photos and ensure consistent weighing and measuring protocols were followed. Photos of each reimbursable meal sold to third grade students were taken at point of sale and tray return. Plate waste was measured (fluid milk) or weighed (food items) at tray return. Research staff collected data of total number of cartons of milk purchased, number servings of food produced, serving portion for menu items, and amounts remaining.

Digital estimates. Research staff estimated plate waste using digital photographs. Trays were numbered (either with marked masking tape or on disposable tray); as students exited the tray line, photographs of trays (without any identifying characteristics of students) were taken. Students proceeded to tables to eat undisturbed. As students returned trays to return window, another photo was taken. Paired comparisons of served and returned trays were made.

Weights and measures. Menu items of sample trays as served were weighed in grams using electronic digital scales (Model MXX-2001, Denver Instruments, Bohemia, NY) and recorded before the meal period. After digital photographs of each tray were taken, remaining foods on trays were weighed or measured. Original protocol called for collection of waste from every fifth tray; however, excluding one building on the first visit, waste of each menu item (grain, meat, vegetable, fruit, and other) from all 3rd grade returned trays was processed. Fluid milk from sold cartons was poured into disposal buckets by flavor of milk with waste measured by volume.

Data Analysis

Questionnaires and Interviews. Responses to interview questions with each stakeholder were summarized, and reviewed independently by two or more members of the research team to identify themes that emerged at each school, followed by discussion to reach consensus.

Plate Waste.

***Digital estimates*.** Numbered photos were compared by two researchers to reach consensus on estimates of served food remaining on each tray. Paired comparisons by tray from both observations in fall (RAL) and in spring (RBL) were combined to determine mean ratings of estimated percent food remaining (1 = no waste; 5 = ¾ or more of product remaining) for each menu component. Mean ratings were summarized for RAL and RBL by each district and for three districts combined for each meal component.

Weights and measures. Weight (grams) for waste of each meal component on each tray was recorded. An assumed mean portion serving size was determined for self-service items. Mean wastes were calculated. Data from collection periods when RAL and RBL were summarized with overall means calculated. Means were calculated in each district by meal component, including fluid milk.

RESULTS AND DISCUSSION

Profile of Districts

A profile of districts detailing characteristics of the nutrition program is shown in Table 1. Offer versus serve was used in all three districts; food was prepared and served on site for one district with two using a centralized production system. All districts allowed 20 minutes for lunch. All of the foodservice directors were in an administrative role, with limited production responsibilities.

Table 1. ***Profile of Participating Schools***

School	Building Grades	District Enrollment	Third Grade Enrollment	District % Free/Reduced Participation	School % Average Daily Participation
1	PK-4	1,288	97	42	65
2	PK-5	4,700	48	50	61
3	PK-5	9,486	70	24	60

Case 1. School 1 was an elementary building housing PK-4 grades within a district of 1,288 students from the entire rural county in adjacent buildings. The district's school food authority was Director of Student Support Services, who worked closely with the foodservice director in administration of SBP and NSLP. This district's elementary program had earned Team Nutrition's HealthierUS School Challenge Award. The total number of third grade students was actually highest of all districts in the study at 97. Average lunch participation for elementary school was 67% with 42% qualifying for free or reduced price lunches. Third grade classrooms were located near the recess area with a restroom and hand washing area nearby. This district installed retractable wall mounted hooks in the cafeteria for outerwear in an effort to expedite transition times when RBL. Building administrators developed a policy which addressed hand washing to guide traffic flow to the cafeteria. Students entered the cafeteria past the cashier, collected trays, served themselves fruit (sliced peaches) and/or vegetable (celery) from the salad bar, selected milk (chocolate or white), and then were served hot food (hamburger on bun), baked beans (upon request or mandatory if no celery or peaches taken), and cookie. Children were directed to specific tables by grades. A lunchroom monitor ensured there were no behavioral problems.

Case 2. School 2 was an elementary building housing PK-5 grades within a district of 4,700 students. The director of the nutrition program had been with the district two years, was a registered dietitian and the school food authority. Two nutrition program staff served meals while the building secretary served as cashier and lunchroom monitor along with scheduled teachers. There were approximately 24 students enrolled in each of the two third grade sections. Average school lunch participation was 50% for the building; 61% qualified for free or reduced price lunches. The school foodservice was a satellite unit. Meals were served in a single line; students selected milk choice from reach-in milk cooler, obtained tray with flatware, and proceeded through the line to select pre-dished trays with entrée (breaded fish on bun) while fruit (options of mixed fruit, applesauce, and bagged apples on days of visits) and vegetable choices (green beans, baby carrots, and broccoli) were available in single service units with a pre-packaged Oreo® cookie. After students received trays, they walked past the cashier to designated tables for their grades. After lunch, children were dismissed by table. Although a hand washing station was located close to the door used to access recess area, it was not observed in use by students during any of the site visits. When RAL, students wore their outerwear to and during lunch. When RBL, students returned to the classroom to hang up their coats before proceeding to the cafeteria. A hand washing stop was not scheduled.

Case 3. School 3 was an elementary building housing grades PK-5 within a district of 9,486 students. The nutrition program director, with a culinary background, was in his first year. This building was staffed by a cook supervisor and additional line staff. The school had earned the

HealthierUS School Challenge Award. There were approximately 35 students enrolled in each of the two sections of third grade. Average school lunch participation was 60% for the building; 24% qualified for free or reduced price meals. Elementary students participating in NSLP at this school had three entrée choices each day: hot entrée, cold sandwich entrée, or salad bar entrée. On days of data collection, the hot entree was a meat-pasta dish and the cold entrée a ham and cheese sandwich (RAL) or turkey sandwich (RBL) served on a whole grain bun. Other meal items were romaine lettuce, sliced cucumbers, and grapes (RAL) or mandarin oranges (RBL). The salad bar consisted of whole grain bun and/or crackers, meat/meat alternate options of pre-portioned turkey meat, cheese, or yogurt, and romaine lettuce, tomatoes, carrots, cucumbers, olives, coleslaw or celery, peaches, and pineapple. Students entered the cafeteria, obtained their trays and flatware, and proceeded down one line if selecting hot or cold entrees or the other line if selecting the salad bar entrée. Fruits and vegetables were self-served from the salad bar with the same options pre-dished on hot/cold entrée line.

A restroom was located adjacent to the cafeteria with doors accessing the outdoor recess area a few yards further down the hall. When RBL, students placed their coats on the floor along the cafeteria wall; rest room breaks and hand washing prior to lunch were at students' discretion.

Questionnaire and Interview Findings

Table 2 displays stakeholders' perspectives of RBL on students' behaviors in the classroom, cafeteria, and physical activity, as well as identification of challenges. Common themes among all stakeholders prior to implementation were that RBL would improve students' lunch consumption and create challenges in scheduling and logistics. However, anticipated improvement in students' lunch consumption was limited as evidenced by spring interviews (RBL). One district's stakeholders perceived the change actually resulted in less consumption because students were talking more, thus decreasing time for eating. All districts indicated they overcame most of the challenges associated with scheduling RBL through good planning and communication; however, limited time for lunch itself with additional transition time needed to don appropriate weather attire was an unresolved challenge. Perceptions related to impacts on behavior in the cafeteria and classroom as a result of recess schedule change varied by districts. These differences may be reflective of building cultures and students' characteristics.

Table 2. ***Stakeholders' Perceptions of Impacts of Recess Scheduled Before Lunch Pre- and Post- Plate Waste Data Collection***

School		Impact on Eating	Impact on Physical Activity	Impact on Cafeteria Behavior	Impact on Classroom Behavior	Challenges
1	**Anticipated (n = 8)**	Stable or increased consumption	No change	Some students rowdier; others calmer and more quiet	Slight increase in focus	1)Schedule changes 2)Winter clothing
	Actual* (n = 6)	No change in consumption	No change	Students rowdier and harder to settle down	Some students calmer; others no change	1)Schedule changes 2)Winter clothing 3)Time to eat
2	**Anticipated (n = 7)**	Increased consumption	Increased physical activity	Rowdier on entry to lunchroom; improved ability to sit and eat quietly	No change	1)Schedule changes 2)Hall transitions 3)Winter clothing
	Actual (n = 6)	Decreased consumption due to increased socializing	Increased student excitement for recess; some with lower activity due to cold weather	Some students rowdier; others more quiet	Some classrooms report fewer problems; others no change	1)Recess overcrowding 2)Staff scheduling changes 3)Hand sanitation
3	**Anticipated (n = 6)**	Increased consumption	Uncertain	Increased student focus on food	Increased calm and engagement	1)Schedule changes 2)Limited transition time 3)Winter gear
	Actual (n = 5)	Uncertain	No impact; students anxious to come inside due to cold or appetite	Stable to slightly more calm	No change	1)Limited transition time

*Proposed solutions for School 1 challenges were: 1) Hall monitor system, 2) Cafeteria coat racks, and 3) Medication plan.

Plate Waste

Overall Digital Estimates. Table 3 displays means of paired photo estimates of meal component waste for all sites RAL and RBL. Photo estimates were corroborated with actual weights and measures, thus providing further support for this less invasive approach to assessing students' plate waste. Visual observations indicated waste of entrée (meat/meat alternate and grain), vegetable and fruit decreased with RBL, respectively.

Table 3. ***Comparison of Estimated Meal Component Waste for RBL and RAL from All Schools***

	Entrée ***M****	**Vegetable** ***M****	**Fruit** ***M****	**Other**** ***M****
RAL Photo Estimate	2.50	3.39	2.99	1.28
RBL Photo Estimate	2.24	3.21	2.58	1.30

*Mean on Likert type scale: 5 = More than ¾ serving remained; 4 = more than ½ to ¾ serving remained, 3 = ¼ to ½ of serving remained, 2 = less than ¼ of serving remained, 1 = no product remained

** Other item at two schools was a cookie.

Weights and Measures. In Table 4, mean weights of food waste by meal component and types of fluid milk are presented for each school. School specific data shows differences with summary photo estimates of waste; this is likely due to sample size and pooling of data. For some items (both food and milk), measured waste often was higher with RBL; this finding contradicts previous work in Montana (Montana Office Public Instruction, 2003) and Florida (Florida Dairy Farmers, 2014). This difference may be due to methodologies of data collection. For all districts in this study, average weight of waste declined for grain, meat/meat alternate and fruit with RBL while vegetable waste increased. In the Florida study, milk waste dropped by 50% among all 1,200 students when RBL; in this study, overall milk waste increased with 24.42 % waste RBL compared to 21.42% waste RAL. Differences in plate waste findings RAL and RBL may be related to acceptability of menu items, different fruits and vegetables served from first visits, other events in the school on measurement days, and culture of the building. While some nutrition staff and lunchroom monitors were observed encouraging children to try food items, there were no consistent policies in place.

Table 4. ***Comparison of Tray Plate Waste at Each School by Meal Component and Type of Fluid Milk***

School and Number of Trays	Meal Component Portion	RAL Waste *M**	RBL Waste *M**
1 RAL = 139 RBL = 134	Hamburger (68 g)	25g	14g
	Bun (60 g)	32g	18g
	Peaches (96 g)	54g	38g
	Baked Beans (84 g)	64g	52g
	Celery (57 g)	39g	23g
	Cookie (29 g)	11g	2g
	White Milk (8 oz)	2.8oz	3.1oz
	Flavored Milk (8 oz)	1.5oz	1.2oz
2 RAL= 56 RBL = 69	Fish (47 g)	47g	50g
	Bun (60 g)	31g	30.5g
	Mixed Fruit (115 g)	58g	50g
	Green Beans (80 g)	26g	35g
	Baby Carrots (60 g)	32g	23g
	Applesauce (125 g)	46g	Not served
	Bagged Apples (65 g)	42g	Not served
	Broccoli (25 g)	22g	Not served
	Oreo (25 g)	1g	2g
	White Milk (8 oz.)	4.6 oz.	3.5oz
	Flavored Milk (8 oz.)	2.7 oz.	1.8oz
3 RAL = 51 RBL = 53	Pasta and Meat (184 g)	80g	81g
	Lettuce (40 g)	20g	22g
	Cucumbers (61 g)	21g	22g
	Grapes (106 g)	63 g	Not served
	Mandarin Oranges (105 g)	Not served	79 g
	Bun (cold entrée) (53 g)	33g	35g
	Ham and Cheese (70 g)	35g	33g
	White Milk (8 oz.)	4.3 oz	3.2 oz
	Flavored Milk (8 oz.)	1.1 oz	1.6 oz

*Mean of waste

CONCLUSIONS AND APPLICATION

Findings from this study were mixed. Based on interview data and plate waste findings, anticipated improvements in students' consumption of food were not realized in all schools. School 1, which had received HealthierUS School Challenge Awards, had lower overall waste. This district has fairly high participation and percent of students who qualified for free and reduced price meals, which may explain less waste. Just prior to the second visit RAL, this school participated in a milk promotion campaign; milk promotion materials were still posted in the cafeteria. This may have skewed consumption and underscores the impact of environmental influences. School administrators had considered logistics of transitioning to a new recess schedule including outerwear storage, hand washing, and holding of lunches from home.

Interview data suggested that of the three schools, the transition to RBL was more readily accepted in this school than the others.

The menu offered at school 2 was clearly not a favorite; in fact, the director had decided to remove it from future cycles due to low acceptability and lower participation. Acceptance of different fruits and vegetables varied. This school offered three choices of milk flavors daily; students preferred flavored milk over white with less waste observed. Lunch room monitors maintained a quiet, orderly environment in the cafeteria.

In school 3, also a recipient of a HealthierUS School Challenge Award, students had three entrée choices, and multiple fruits and vegetables were offered through the serving line or self-served salad bar. Of the 25 to 30 students who participated in the NSLP on days of data collection, half to two-thirds selected the prepared hot or cold entrée with others opting for salad bar meal. Nutrition staff were friendly and encouraged students to try new foods; yet service requirements and limited number of staff did not facilitate consistent practice. Future research should investigate the influence of onsite staff encouragement on students' selection and consumption of foods.

While all three schools provided 20 minutes for lunch, the number of students served during the meal period, and the time needed for student selection of choice items and service of meals varied, resulting often in only 10 minutes actually available for consumption and socialization. District administrators should consider actual time students have for eating of lunches rather than simply scheduling a block of time; many factors affect efficiency of service, time for student decision-making, and staff interactions.

Pooled data plate waste photo estimates suggested less waste with RBL; however, when measurements of waste were averaged within each school, there were components of the meal that had more waste in two of the schools when RBL. These mixed findings are similar to results reported from other research (Cohen et al., 2013; Schwartz et al., 2015). The detailed analysis of plate waste by student tray and meal component, including type of milk served, was a different approach than bulk waste collection used in prior work.

Recess scheduling is just one factor; findings from this study indicate it may not be the only variable for consideration when evaluating students' food and milk consumption. Findings from this study support the importance of offering food items preferred by children; it was clear certain vegetables did not appeal to this particular group of third graders, regardless of service style or district characteristics. While fruit and vegetable or salad bars increased number and variety of options, the self-serve nature of these allowed only for estimates of waste as portions served varied with each child. Future research could investigate impact of self-service options and number of choices on time for eating and actual consumption. The district in which communications among nutrition program staff, administrators and educators addressed logistical considerations (such as outerwear) and existing traffic flows appeared to reap benefits of RBL on reduced plate waste. This finding supports that of Bounds et al. (2009). Results from this study suggest the environment influences student consumption of NSLP meals in addition to scheduling of recess.

Milk waste was markedly less with flavored milks. While service of these has been controversial, findings from this study suggest these options result in greater consumption. Further research is needed in this area.

Perceptions of student behavior were also mixed. While generally it was perceived at the outset RBL would decrease behavioral issues, themes that emerged in interviews and surveys following the schedule change found impact was less than expected.

Previous work has focused on a singular approach to plate waste assessment by either total weights of all tray waste combined or use of digital photography only for waste estimates. Further, much of the past work has collected plate waste data on one day, rather than multiple occasions. This study provides a detailed breakdown of a reimbursable meal's waste with contextual understanding of the environment. Based on findings from this work, building administrators considering RBL would be advised to include all building stakeholders in decision making and assess not only menu items but also environmental factors. A guide has been created that includes tools and best practices to assist schools in the determination of making the change to recess before lunch. The guide includes a readiness checklist that addresses factors to consider: staff and student support, lunchroom seat time, nutrition staff schedules, recess/hall supervision, hand washing, recess clothing management, and children with medical needs. The guide also includes an overview of impacts of scheduling recess before lunch on plate waste and perceptions of student behavior. The guide is located on the USDA State Sharing Center webpage (See https://healthymeals.nal.usda.gov/state-sharing-center/iowa) and available as a resource to all interested parties.

While this project does provide detailed data regarding plate waste and recess scheduling, there were limitations. One limitation was that self-service fruit and vegetable salad bars confounded ability to summarize plate waste calculations given variations in choices and portion sizes; thus estimates of portion size were used. Another limitation was the halo effect; it was not clear how researchers' presence affected students' meal consumption or the lunch service process. However, multiple visits offsets this limitation to some degree.

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