Plate Waste in School Lunch: Barriers, Motivators, and Perspectives of SNAP-Eligible Early Adolescents in the US

Chenchen Zhao, MS¹; Chloe Panizza, MS, GradDip Diet¹; Kira Fox, BS¹; Carol J. Boushey, PhD, MPH, RD²; Carmen Byker Shanks, PhD, RDN³; Selena Ahmed, PhD³; Susan Chen, MS⁴; Elena L. Serrano, PhD⁴; Julia Zee, MPH, RDN¹; Marie K. Fialkowski, PhD, RDN, LD¹; Jinan Banna, PhD, RDN¹

ABSTRACT

Objective: To determine barriers, motivators, and perspectives regarding plate waste reduction of early adolescents.

Design: Trained interviewers conducted audio-recorded individual interviews with adolescents.

Setting: Elementary schools implementing the *National School Lunch Program* in Hawai'i, Montana, and Virginia.

Participants: Early adolescents (n = 47, aged 9–13 years) from families receiving or eligible to receive *Supplemental Nutrition Assistance Program* benefits were recruited to participate.

Phenomenon of Interest: Factors influencing plate waste among adolescents and potential plate waste reduction strategies.

Analysis: Coders analyzed content and thematic data to identify code categories and themes.

Results: Main barriers to reducing school lunch plate waste were unsupportive school policy, undesirable food quality, satiation, and social influences. Key motivators to reducing school lunch plate waste were supportive school policy, including allowing students to share food with peers and save food to eat later; and social influences. Participants found it acceptable to throw away disliked food and unacceptable to throw away wanted food; they perceived that their peers did not care whether food was thrown away; and they thought their parents disliked wasting food.

Conclusion and Implications: Results suggest that several factors might allow for minimization of school lunch plate waste in the *National School Lunch Program*, including improvements in food quality, food policy, and social influences. Under these important themes, strategies to employ may include improving food preparation and taste, allocating more time for students to finish lunch, allowing students to self-select food lunch items, and permitting them to share and save their leftover food.

Key Words: early adolescents, food waste, *National School Lunch Program*, plate waste, school lunch (*J Nutr Educ Behav.* 2019; 51:967–975.)

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INTRODUCTION

Poor diet is particularly of concern for low-income students eligible for

federally assisted meal programs such as *Supplemental Nutrition Assistance Program* (SNAP), who have been shown to be at increased risk for

diet-related conditions such as overweight and obesity.¹ School is an important setting for promoting a healthy diet, because students consume a significant number of daily calories in this setting. Although students may be provided meals meeting the dietary guidelines² at school, school lunch plate waste may negatively affect dietary intake and lead to inadequate intake of important nutrients. School lunch plate waste not only affects lunch quality and students' nutritional intakes in school, it causes problems beyond school, such as excess methane and CO₂ emissions in the environment, which may have an impact on global climate change.³ Besides the nutritional and environmental cost of plate waste, the economic cost of

¹Department of Human Nutrition, Food, and Animal Sciences, College of Tropical Agriculture and Human Resources, University of Hawai'i at Manoa, Honolulu, HI

²University of Hawai'i Cancer Center, Honolulu, HI

³Department of Health and Human Development, Montana State University, Bozeman, MT

⁴Department of Human Nutrition, Foods, and Exercise, Virginia Polytechnic Institute and State University, Blacksburg, VA

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Address for correspondence: Jinan Banna, PhD, RDN, Department of Human Nutrition, Food, and Animal Sciences, College of Tropical Agriculture and Human Resources, University of Hawai'i at Manoa, Agricultural Sciences 216, 1955 East-West Rd, Honolulu, HI 96822; E-mail: jcbanna@hawaii.edu

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plate waste nationally is over \$600 million/y.⁴ Hence, it is important for foods served in schools to meet the nutrition standards and for plate waste to be minimized to optimize students' nutrient intakes and minimize environmental and economic costs.⁵ Completely eliminating school lunch plate waste likely is unrealistic; however, understanding factors related to reducing lunch plate waste is important for efficiency, cost, and nutritional intake of students.⁶

To the authors' knowledge, no known studies have explored barriers, motivators, and perspectives regarding reducing plate waste in schools through interviews with low-income children eligible for SNAP. Identifying factors contributing to plate waste in school has the potential to improve food consumption. Understanding barriers and motivators for plate waste reduction may result in improving participants' eating behaviors, tailoring nutrition education programs, and minimizing school lunch plate waste.⁷ This study was designed to document barriers, motivators, and perspectives regarding plate waste in schools to inform strategies to reduce plate waste.

METHODS

Participants and Recruitment

Participants were early adolescents, aged 9–13 years, from families receiving or eligible to receive SNAP benefits in Hawai'i, Montana, and Virginia. Researchers at each institution had previously collaborated on school lunch plate waste research.⁶ This multisite recruitment process benefits the study to learn about a diverse range of experiences of students' lunch consumption and offer a high-quality and more multi-ethnic and representative sample. Non-SNAP receiving students were not included in this study, and it is not defined in this research whether there were significant differences in plate waste between those who were eligible for SNAP and those who were not. Researchers recruited students from elementary schools implementing federally assisted meal programs by contacting after-school

programs and then approaching parents when they came to pick up their children; they also distributed flyers. Adolescent participants were diverse in ethnicities, included white, Native Hawaiian or other Pacific Islander, Asian, Hispanic, black/African American, and American Indian or Alaskan Native. Students were recruited separately from Hawai'i, Montana, and Virginia. In Hawai'i, children were recruited from 3 different schools, which were kindergarten (K)–6 (314 student enrolled in 2016–2017, urban), K–8 (423 student enrolled in 2016–2017, urban), and K–12 (359 students enrolled in 2018, rural). At this site, all students received free or reduced-cost meals. In Virginia, participants were recruited with the help of a community member in a rural area in which most schools had high rates of free and reduced-cost meal programs. The Montana site data came from 2 elementary schools. Both had 250 students and were located in an urban-rural area. At the first school, 60.5% of students received free or reduced-cost lunch through the *National School Lunch Program* (NSLP). The first school had 18% students eligible for free and reduced-price lunch in the NSLP and used offer vs serve (OVS). The second was oriented with offer vs serve but only 11% of students were eligible for free and reduced-price lunch through the NSLP. Parents and participants signed consent and assent forms, respectively. The researchers explained the forms verbally to the parents and participants before they signed. This study was approved by the Institutional Review Boards at the University of Hawai'i, Montana State University, and Virginia Polytechnic Institute and State University.

Procedures

Semistructured interviews. At each site, trained research assistants conducted interviews using a semistructured interview guide that was originally pilot-tested with 3 participants at the Hawai'i site. Interviews were selected as the data collection method rather than focus groups because the researchers were interested in concepts regarding lunch plate waste

that may be unique to individual students, such as personal perspectives, as well as those of peers and parents. The interview guide was developed by the lead researcher in Hawai'i by reviewing existing literature on school lunch plate waste in the US. Existing literature was reviewed for factors associated with plate waste in quantitative studies and any proposed strategies to reduce lunch plate waste. The interview guide was further reviewed and approved by the lead researchers in Montana and Virginia. Examples of questions asked were *When you finish lunch, is there ever food left on your plate? If so, why? What type of food is usually left on your plate? What happens to this food? Why?* Interviewers followed up with probes as to why food was discarded. The interview guide focused on prompting students to state their perceptions regarding factors contributing to school lunch plate waste. The [Supplementary Table](#) provides an example of questions posed with regard to lunch at school. The lead researcher at each institution, who had extensive experience in qualitative data collection, trained research assistants at each site. All one-to-one interviews with participants were conducted using the interview guide and audio-recorded. After each interview, researchers at the Hawai'i site listened to the recorded interview to see whether new ideas emerged from the interviews. If there were any, these were added as new codes to the codebook. Once each interview was finished, 1 researcher listened and transcribed the interviews and a second researcher checked that each interview was transcribed correctly. Once transcribed, all transcripts were imported into NVivo qualitative data analysis software (version 10, QSR International, Inc, Burlington, MA; 2012).

Data Analysis

Directed content analysis was used to analyze interview transcripts using NVivo. One researcher in Virginia and a second one in Hawai'i coded 3 randomly selected transcripts to ensure interrater reliability and achieved a mean Cohen kappa coefficient of 0.68, which is considered a

moderate level of agreement.⁸ The 2 researchers then independently coded all transcripts using the shared codebook and evaluated key themes. These 2 researchers then independently examined the codes and merged similar ones into a higher-order category, which became the final set of codes. The final higher-order categories were social, policy, hunger, and quality for both the barriers and motivators. For instance, codes from students claiming lunch plate waste was related to food texture, food taste, and the smell of food were merged under the higher-order category of quality. The higher-order categories for perspectives included *It's okay to waste food*, *Against plate waste*, and *Neutral to plate waste*. The 2 researchers agreed on the higher-order categories and independently looked for important emerging themes by reading quotations in each higher-order category. In discussion, the 2 agreed upon final themes and summarized results regarding main barriers, motivators, and participant perspectives on plate waste. Validity was ensured using 2 strategies: (1) use of a shared codebook containing operational definitions of codes, and (2) discussion and debate of main themes identified between the 2 researchers.

Sample size was determined by data saturation, which indicated the point at which no new information could be retrieved from the data.⁹ Once no new ideas emerged from the interviews upon listening to each recorded interview, the researchers concluded that they had reached data saturation. Data saturation occurred after 27 participants were interviewed.

RESULTS

Participant Characteristics

In total, 47 interviews were conducted with adolescents from Hawai'i (n=27), Montana (n=10), and Virginia (n=10). Table 1 provides a characteristic profile of study participants. The majority of study participants were non-Hispanic white (60%), whereas black/African American and Indian or Alaska Native respondents were the least dominant populations

Table 1. Characteristics of Adolescents Aged 9–13 Y in Hawai'i, Montana, and Virginia (n = 47)

Variable	n	%
Age, y (mean [$\pm$ SD])	11 ($\pm$ 1.58)	
9	9	19
10	14	30
11	10	21
12	5	11
13	9	19
Child ethnicity		
White (non-Hispanic)	28	60
Native Hawaiian or other Pacific Islander	2	4
Asian	5	11
Hispanic	3	6
Black/African American	1	2
American Indian or Alaska Native	1	2
Two or more races	7	15

in this study. Approximately 30% of participants were aged 10 years.

Themes Related to Reducing School Lunch Plate Waste

Based on the data, themes with various subthemes were identified related to school lunch plate waste reduction (Figure).

Barriers to Reducing School Lunch Plate Waste

Major barriers to reducing school lunch plate waste were food quality and the influence of school policy. Table 2 presents a selection of quotations from students regarding barriers to reducing school lunch plate waste. Minor barriers were hunger and social influences. Participants often commented negatively on the taste and texture of food served, stating food was *weirdly cooked*, *always really salty and mushy*, *prepared in a clumpy and soggy way*, *spoiled-tasting or burnt*, and *pieces make me choke*. Some participants also commented that the school should have *non-genetically modified organism food*.

Comments regarding the influence of school policy on lunchtime plate waste were coded into 2 subcategories. The first was policies affecting how food was prepared and served in these schools. Many participants commented that they had no choice regarding what types of foods

were served for lunch, and they did not have enough time to finish eating the lunch in the set lunch period. The second category included policies affecting how food was disposed of once the participant had finished eating. Participants commented that once they had finished eating, they were not able to share unwanted food with friends, they could not save their leftovers, uneaten food had to be discarded in the trash, and there were no opportunities to compost leftover food. Regarding the barrier of lack of hunger, some participants said that they had leftover food at lunch because they were still full from breakfast. Social influence was also a minor barrier that was identified. For example, participants mentioned that they were unable to finish their food because they were distracted by peers.

Motivators to Reducing School Lunch Plate Waste

Main challenges to minimizing lunch plate waste were identified as school policy and food quality. Motivators to reducing plate waste are shown in students' suggestions: (1) regulate school policies to permit self-selection of foods at lunch time; (2) investigate food sharing options with peers among students; (3) allow uneaten, intact food items to be redistributed or saved for later; (4) offer high-quality, wide-variety, and well-prepared,

Figure. Themes and subthemes identified related to school lunch plate waste reduction.

nutrient-dense foods; and (5) involve students in taste-test programs. According to their responses, the most important motivators for

reducing plate waste in these schools school policy and food quality. Social influence was regarded as a minor factor (Table 3). Participants commented

that they had no leftovers when the food was healthy and they liked the taste. With regard to school policy, participants commented that if their school allowed them to share their uneaten food, this might reduce plate waste. Composting or giving leftovers to animals was also highlighted as a way to reduce the amount of plate waste thrown into the trash. Finally, participants commented that they finished their food when influenced to do so by their peers.

Perspectives on Reducing School Lunch Plate Waste

Important themes emerged regarding what participants perceived their parents' and peers' perspectives to be about plate waste, as well as their own personal perspectives. The majority of participants said that their parents disliked wasting food; for example, a participant said she tried to save or finish all of her food because her parents disliked wasting food. Participants commented that their peers tended to waste food, or they were unsure how their peers felt about wasting food. For example, common quotations were *They don't care* and *I don't know*. Participants believed it was personally acceptable to throw away undesirable food and it was unacceptable to throw away wanted food (Table 4).

Plate waste is child, community, and foodservice related. Factors related to plate waste include palatability, taste preferences, lunch duration, school policies, and coordination. Improving food quality and allowing food choice in schools may minimize school lunch plate waste.

DISCUSSION

This study highlights some of the critical barriers, motivators, and perspectives regarding school lunch plate waste among early adolescents from low-income families. Findings may inform practices in the NSLP, a federally assisted meal program in the US that began providing low-cost and free school lunch meals to students in 1946.¹⁰ It is estimated that 30.4 million students participated in the low-cost or free lunches program in 2016.¹⁰ In 2010, the Healthy,

Table 2. Important Barriers to Reducing Plate Waste in Early Adolescents Aged 9–13 Y (n = 47) in Hawai'i, Montana, and Virginia

Barriers	Representative Quotations From Participants
No food choices at lunchtime	Usually the cafeteria decides how much we are served. We don't usually get seconds, but only if there's a lot more than usual, then we're allowed to have seconds. The lunch lady puts the food on my plate. It was all on the plate. They just give the lunch to us. They just give you a tray of food. They don't let us choose. The lunch ladies give it to us. We don't decide.
Poor food preparation and cooking methods	I don't know. It's clumpy and soggy. I think the way they prepare the meat is good most of the time but sometimes it has too much seasoning on it or just doesn't look like edible. Well, not as much nutrients and the food fills me up. Because they just give us gross food. Last time, they burned the carrots. Sometimes they cook nasty stuff.
Cannot save leftovers because of school rules	If they catch you trying to save food, you get in trouble. I never once got caught, because I used to just roll up the bread in a ball and hold it, put it in your pocket, or put it in your mouth. I think at school because they don't like to save it. Because sometimes they're not hungry and they have nowhere to save it. The school doesn't really save it for anybody else. They just throw it because they just make us empty at a certain time. The stuff that we have left we put it on our tray, and we go dump our tray. It gets thrown away.
No sharing with others because of school rules School rules require students to throw food away	We don't have the opportunity to share with other people if they want my lunch. They say, 'No sharing food!' Throwing food away is the rule to go to recess. They have to throw it out. We walk over to the garbage can, dump it, and then put our tray in a pile.

Note: Quotations were edited by the authors to correct grammar.

Hunger-Free Kids Act (HHFKA) was passed, which allowed the US Department of Agriculture (USDA) to make critical improvements to foods served in the NSLP.¹¹ In response to the HHFKA, the USDA released new nutrition standards for the NSLP and School Breakfast Programs in 2012–2013.¹² These nutrition standards focused on reducing sodium and saturated fat in school meals, as well as increasing whole grains and fiber.^{12,13} These standards also set minimum requirements for protein, calcium, iron, vitamin A, and vitamin C in school meals.¹³

Although these changes to the nutrition standards linked to the HHFKA were important, the standards are based on the assumption that all foods and beverages served in the NSLP are consumed.^{7,12} Previous studies^{4,6} provided evidence of a

significant amount of plate waste (the edible portion of foods served but not consumed) in the NSLP. The NSLP set new standards for minimum and maximum levels of energy (kilocalorie) intakes and placed restrictions on total and saturated fat. Recently, the program also set minimum levels for protein, calcium, iron, vitamin A, and vitamin C.^{12,14} However, previous research^{4,15,16} found that intakes of calcium, iron, zinc, and vitamins A and C were below the recommended amounts to be supplied by the school lunch when foods were being served but wasted.

These findings may inform future strategies to reduce plate waste in the NSLP. Poor food quality was repeatedly reported as a barrier, and desirable food quality as a motivator, to reducing plate waste. Students particularly mentioned the ways in which

foods were cooked and the texture of those foods. Previous studies^{17,18} also found that improving the palatability of food reduced plate waste and increased nutrient consumption at school lunch.¹⁹ Studies also suggested that integrating more fresh and local produce into school lunches may increase the consumption of food in schools. Furthermore, because previous research¹⁸ indicated that fresh or raw vegetables are wasted less than cooked, providing such items to address students' concerns about cooking methods may be a useful strategy.

School policy was also identified as a key barrier and motivator to reducing lunchtime plate waste. For example, many participants commented that they did not have enough time to finish eating lunch during the set lunch period. Previous studies^{6,20–23}

Table 3. Important Motivators to Reduce Plate Waste in Early Adolescents Aged 9–13 Y (n = 47) in Hawai‘i, Montana, and Virginia

Motivators	Representative Quotations From Participants
Self-select foods at lunchtime	They could probably let us choose what goes on our plate, and how much is put onto our plate. They could just have a bunch of sauces, and then, like private schools, where you get to pick your food. You'd eat more of your food if you got to choose what you could. Maybe have a few different choices.
Save food in cafeteria	In the morning, go around to kids and ask them, 'What kind of foods do you like?' They should give us a choice of drinks. They should give us a juice box or milk. Probably put the rice back in the rice cooker if they haven't touched that. If they don't drink the milk, they can save it. You can put the leftovers next to the trash cans and someone else can take it. Maybe they put it in the fridge until it expires and then to the trash. If there is too much, they give the leftover food to the employees so they can take it home, or even give it back to the cafeteria.
Share food with peers	I didn't want to eat, because the boys were making me mad, and I got distracted. Because my friends don't like food waste, so I make sure I eat everything, too. We could give it to the people that like the food at school. But that could be given to somebody else. Someone ends up asking for it, so I give it to them.
Allow students to save food	Some kids save it because they just hold it in their hands so that they can eat it at recess. We wait until school's over to eat it. They say you can take leftover food, but you can't eat it in class. You can eat it after class.
Improve food quality and variety	Instead of having rice every day, change it up and make it more interesting by providing us with new foods. More variety. You get a little bored with the same lunch. It's always really salty and mushy. They should get fresh food. When you get the food the day before, and then the other day you cook. At least make it look better and stuff so people can actually eat more and not throw away or throw away less food. Maybe buying better ingredients.

Note: Quotations were edited by the authors to correct grammar.

also found that school policy influenced plate waste in the NSLP. Allowing students enough time to eat lunch was highlighted in many studies as a strategy to both reduce plate waste and increase nutrient consumption.^{20,24–27} Cohen et al²⁰ reported that students who had < 20 minutes to eat lunch consumed 12% less of their entrées, milk, and vegetables than did students who had at least 25 minutes to eat lunch. Also, extending students' lunch periods to allow adequate time to finish lunch reduced plate waste from 43.5% to 27.2%.²⁷ Additional research reported that inadequate time to finish lunch not only increased plate waste but left students feeling hungry.¹⁹ This inadequate energy intake drives students to look for salty and/or sugary

snacks and beverages from nearby vending machines and food establishments.^{19,28} Studies suggested that those involved in writing school policies should allow reasonable and sufficient lunchtimes for students to be directed and seated, wait in the lunch line, eat, and clean up.²⁹ The Cornell Center for Behavioral Economics in Child Nutrition Programs is the home of the Smarter Lunchrooms National Office, which provides tools, training, and support to schools in the US to improve students' nutrient intake.³⁰ This program also recommends extending the lunchtime period and increasing the variety of food served in the NSLP, allowing students to serve themselves, and offering ready-to-eat or sliced fruit and vegetables to improve

nutrient intakes.³⁰ These suggestions are in line with the barriers and motivators participants expressed in the current study; many mentioned that they had no choice about what foods were served at school lunch. Previous research^{4,7,31,32} concluded that plate waste was lower when students were allowed to select their own lunch components. For example, when schools offered a variety of fruits and vegetables as well as different flavored milks, consumption of these items increased and plate waste decreased.^{33,34} Encouraging students to keep food items for after-school activities, prepack foods for students who do not have enough time to eat, and share unopened foods such as packaged milk also optimized food intake and reduce plate waste.³⁵

Table 4. Important Perspectives on Plate Waste in Early Adolescents Aged 9–13 Y (n = 47) in Hawai'i, Montana, and Virginia

Perspectives	Representative Quotations From Participants and Their Responses for Their Peers and Parents
Pro food waste	<p>I wouldn't mind, because if I didn't like it, it would probably be better because they can be compost, too.</p> <p>It might have tasted good, but then I just threw it away?</p> <p>No foods are really okay to throw away, but I don't feel bad about throwing my school lunch away.</p> <p>My peers don't care. They just throw it away and go away.</p> <p>There are so many kids. It's very likely some of them don't care.</p> <p>My parents don't care.</p>
Against food waste	<p>Well, I feel bad because across the street we have people that do not get to eat every day, so I try to eat as much as I can.</p> <p>I feel bad because it's wasting.</p> <p>I don't have any specific foods that I would feel bad about throwing in the trash, but I think everything.</p> <p>My peers feel bad about throwing food in the trash.</p> <p>I'm sure some of my peers feel bad about it, but most probably don't think about it.</p> <p>My mom doesn't really like wasting food, and sometimes my mom's boyfriend doesn't either. He said, 'You should eat all that food on your plate because you should be happy that you have food.'</p>
Neutral	<p>I don't really care about food because again, I am not a fat person. I don't really care. I would say I care about people that are starving, but I don't eat that much food.</p> <p>I feel sad and happy at the same time.</p> <p>It feels neutral about throwing food away.</p> <p>I think my friends feel a little bit bad, but I don't know about other people.</p> <p>Probably neutral, but I don't know about others.</p> <p>My parents do mind because there is starving children, but they don't mind. It's 50:50.</p>

Note: Quotations were edited by the authors to correct grammar.

These ideas are also in line with the barriers participants expressed in the 3 states included in the current study.

This study had a number of strengths and limitations. Previous studies^{4,19,23} provided quantitative evidence and measurements of substantial plate waste in the NSLP as well as plate waste-related economic loss. However, little attention was paid to assessing factors contributing to plate waste and developing strategies based on children's personal perceptions. Strengths include its being an innovative qualitative study that interviewed students about their barriers, motivators, and perspectives regarding reducing plate waste at school lunch. Diverse, multiethnic students were interviewed from 3 states across the US which collectively enhances the generalizability of this study to other schools and students in the US. A limitation of this study was that only students were interviewed; therefore, perspectives from other important stakeholders,

such as parents and teachers, within the context of this sample are unknown. In addition, only children eligible for SNAP were recruited. Thus, it was not possible to assess differences in plate waste after eating school lunch between children who were eligible for SNAP and those who were ineligible. Another limitation is that the impacts of the identified barriers, motivators, and perspectives on plate waste were not assessed. Further analytical studies are required to investigate this. Finally, although the sample was multiethnic and recruited across 3 US states, the results may not be representative of plate waste behaviors for all students in the US, because food preparation and foodservice techniques are unique to each school.

IMPLICATIONS FOR RESEARCH AND PRACTICE

Plate waste is a problem among adolescents in the US. The nutritional,

environmental, and economic consequences of plate waste should draw the government and schools' attention. To the authors' knowledge, the current study is the first perception-focusing research that resulted in recognizing and reporting plate waste at school lunch as a problem. The interpretation of barriers, motivators, and perspectives regarding early adolescents reducing plate waste has critical implications for establishing future plate waste reduction strategies. A clearer understanding of individual perceptions of school lunch plate waste among students may help schools embed nutrition education to reduce plate waste.

Results of this research based on students' views of school lunch could be used as a valuable reference for training programs for cafeteria staff to better address students' emotional and nutritional needs to increase school lunch consumption. Schools with trained staff who are familiar with students' needs could better direct and assist children to develop

healthier eating behaviors. For example, previous studies^{14,36} comparing schools that had trained chefs with control schools showed that schools with trained chefs promoted increased whole grain and vegetable selection among students.

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SUPPLEMENTARY DATA

Supplementary data related to this article can be found at <https://doi.org/10.1016/j.jneb.2019.05.590>.

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JNEB Call for Papers: Sustainable Management of Food

An important aspect of the sustainable management of food that is within JNEB's scope is investigation of reductions in food loss and waste that involve behavioral changes.

Authors do not need to make a clear connection between their intervention and increasing sustainability, but acknowledgement of this link should be evident in the Introduction and Implications sections, with caution not to overstate results.

Examples of papers that would fall with this topic include:

Food Waste in a School Nutrition Program After Implementation of New Lunch Program Guidelines. Carmen J. Byker, Alisha R. Farris, Michael Marcenelle, George C. Davis, Elena L. Serrano. *J Nutr Educ Behav*. 2014;46(5):406–411.

Factors Influencing Fluid Milk Waste in a Breakfast in the Classroom School Breakfast Program. Stacy A. Blondin, Jeanne P. Goldberg, Sean B. Cash, Timothy S. Griffin, Christina D. Economos. *J Nutr Educ Behav*. 2018;50(4):349–356.

A Plate Waste Evaluation of the Farm to School Program. Jaclyn D. Kropp, Saul J. Abarca-Orozco, Glenn D. Israel, David C. Diehl, Sebastian Galindo-Gonzalez, Lauren B. Headrick, Karla P. Shelnutt. *J Nutr Educ Behav*. 2018;50(4):332–339.

Submissions close April 15, 2020.