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A Mindful and Sustainable Eating Intervention to Improve Attitudes Related to Mindfulness, Sustainability, and Fruit and Vegetable Consumption in Elementary Schools

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Excessive plate waste is generated in elementary school cafeterias. Adapting nutrition promotion strategies to target waste reduction and encouraging mindful and sustainable eating (MSE) are possible strategies to encourage students to reduce waste during school lunch. Farm to Tray, Tray to Farm *is a 16-week intervention that aims to encourage elementary school students to develop mindful and sustainable eating behaviors. An educational curriculum was delivered to eight 5th-grade students, who served as peer leaders and disseminated messages throughout the school. Additional strategies included cafeteria reinforcements and opportunities for food recovery. A pilot test of the program was conducted in two schools using a quasi-experimental design. A pre/post survey was administered to 3rd–5th-grade students to measure changes in MSE behaviors, and analyses were conducted using the test of marginal homogeneity and t-test for independent samples to evaluate within- and between-group differences, respectively. In total, 169 students (n = 102 intervention and n = 67 comparison) completed both surveys. From baseline to follow-up, intervention students reported significantly increased self-efficacy to base lunch choices on body cues. A higher proportion of intervention than comparison students increased ratings regarding behavioral strategies to practice MSE and expectations of benefits from MSE.*

Keywords: plate waste, elementary schools, National School Lunch Program, pilot study, peer modeling

Introduction

Estimates of plate waste from school meals indicate between 14% and 31% of the food served to students is discarded, with the highest rates occurring for vegetables in elementary schools (Byker et al., 2014; United States Department of Agriculture [USDA], Food and Nutrition Service, 2019). Many recommendations to reduce plate waste overlap with nutrition promotion strategies by addressing student knowledge, ability, and willingness to consume healthy foods (Blondin et al., 2014; Guthrie & Buzby, 2002; Zhao et al., 2019). Cafeteria-based environmental strategies that support healthy eating include making healthy foods more attractive and available

(Hakim & Meissen, 2013; Kessler, 2016). These techniques have been extensively evaluated in nutrition programs, and adapting them to target waste reduction could be an effective approach.

Emphasizing mindfulness in nutrition promotion offers an additional opportunity to encourage improved dietary intake among students with less waste (Jordan et al., 2014). While limited research on mindful eating in schools exists, a recent intervention emphasizing sensory activities and understanding hunger cues showed promising results for increasing preference for fruits and vegetables (FV; Pierson et al., 2016; Wylie et al., 2018). A related concept, appreciation for food, is associated with attitudes and preferences toward healthy food and healthy eating behaviors among school children (Fung et al., 2016; Kawasaki & Akamatsu, 2020). Expanding understanding of mindful eating to emphasize relationships among food choices, sustainability, and social justice is a possible strategy to encourage students to consider the implications of waste that they produce (Fung et al., 2016).

Designing programs that offer environmentally focused, or "ecoliterate," education is a potential approach to incorporating sustainability efforts into mindful eating (Goleman et al., 2012). Ecoliteracy develops when the symbiotic nature of social and ecological factors is emphasized, and children are encouraged to develop solutions to complex health and environmental challenges (Goleman et al., 2012). When themes of sustainability and social justice are incorporated, encouraging mindful eating supports ecoliterate and healthful behaviors (Pierson et al., 2016).

This article describes *Farm to Tray, Tray to Farm* (*FTTF*), a 16-week intervention consisting of (1) a series of eight biweekly education sessions for peer leaders, (2) cafeteria reinforcements, and (3) an expanded share table that aimed to encourage elementary school students to develop mindful and sustainable eating (MSE) behaviors, where students consider nutritional, environmental, or social implications of their food choices, to meet child nutrition goals while encouraging more sustainable waste disposal.

Program Structure

The intervention, known as *FTTF*, consisted of three strategies. The first strategy is a 16-week mindfulness and ecoliterate curriculum. A series of eight lessons (see Table 1) were delivered over a 16-week period to a group of eight 5th-grade students, known as Veggie Leaders (VLs). The interactive lessons comprised the educational component of *FTTF* and were adapted from published resources and covered nutrition, sensory exploration of food, the food system, and other topics (Costello & Schepers, 2007; Johns Hopkins Center for a Livable Future, n.d.; Pierson et al., 2016; Wylie et al., 2018). Changes were made to lessons to simplify concepts to make them understandable for elementary students or abbreviated due to time constraints, as necessary. Each of the eight lessons was covered over two weeks, during which the main educational content was introduced to VLs during the first week, and VLs prepared materials and activities (e.g., mindful eating contests, educational artwork, story writing) to disseminate key

concepts throughout the school during the second week. Dissemination activities gave VLs an opportunity to act as peer leaders, and they introduced MSE concepts and promoted their work during morning announcements. The second strategy, cafeteria reinforcements, was designed to emphasize available FV choices and reiterate key messages. They included placing an FV menu at the cafeteria entrance, labeling foods on the tray line, and displaying a feedback board with questions related to study lessons. Strategy 3 is an expanded share table. Share tables/bins allow students to donate and retrieve certain foods (such as milk, whole fruit, or packaged snacks) and help reduce waste. Prior to the study, both schools had small share bins; the bin at the intervention school was expanded as part of the study. In consultation with the school, recovered items were donated to after-school programs. Donated foods were stored on ice (for cold items) or in labeled baskets to maintain food safety and organization. Cafeteria staff monitored the expanded table and collected the remaining foods for storage at the end of lunch.

Table 1. Overview of Education Component of FTTF Disseminated by Veggie Leaders to the Intervention School

Topic	Interactive Lesson Activities	Dissemination Activities	Related Evaluation Constructs
1) MyPlate	• Matching game for foods/food groups; • Sharing health benefits of favorite FV	• Educational artwork for cafeteria	• Knowledge of basic nutrition • Expectations/ importance of health benefits from FV
2) Exploring our Food System[1]	• Game to visualize connections in food system; • Reading story about steps in food system	• Wrote simplified version of story for young students	• Knowledge about people and resources involved with growing and producing food
3) Sensational Senses[2]	• Brainstorming neutral descriptors for food; • Exploring foods using all senses	• Prepared take home mindful eating activity	• Knowledge about mindful eating concepts • Self-efficacy to explore sensory aspects of food
4) Why We Eat What We Eat[1]	• Debate on causes of food choices; • Drawing “healthy food environments”	• Brainstormed cafeteria changes to encourage healthier choices	• Self-efficacy to identify external influences on food choices • Intentions for navigating external influences
5) Getting to Know Hunger and Fullness[2]	• Demonstration of hunger and fullness concepts; • Group snack to identify physical sensations	• Created hunger cue scales; • Prepared mindful eating activity	• Self-efficacy to recognize internal hunger cues • Behavioral strategies to identify/respond to hunger cues
6) Our Wasted Food[1]	• Discussion of food waste through supply chain; • Food recovery hierarchy activity	• Staffed health fair table about food waste	• Knowledge about nutritional/ environmental impact of food waste • Behavioral strategies to reduce waste

Topic	Interactive Lesson Activities	Dissemination Activities	Related Evaluation Constructs
			• Expectations/ importance of nutrition-related benefits from waste reduction
7) The Hunger Gap[1, 3]	• Discussion of food insecurity; • Writing activity about local food insecurity	• Created artwork for cafeteria to promote food recovery	• Knowledge about impact of food insecurity (globally and locally) • Intentions to improve food security in community
8) Planting the Seeds of Mindfulness[2]	• Started seeds to show effort of food production; • Mindful eating practice	• Prepared take-home mindful eating activity	• Knowledge about connections between food production and mindfulness • Self-efficacy to continue expanding MSE skills

Note. [1]Adapted from *FoodSpan* curriculum; simplified for audience age; [2]Adapted from *Foodie U* curriculum; shortened for time constraints; [3]Messages from *Feeding Minds, Fighting Hunger* incorporated into lesson

Development of the Program

Using a quasi-experimental non-equivalent groups design, *FTTF* was pilot-tested in the Spring of 2019 at two of five elementary schools in a Maryland school system. After approval by the school board, investigators reviewed study procedures with principals, who provided written consent for their schools to participate.

To assess the effect of the intervention, we designed and administered pre- and post-surveys to a subgroup of students. All teachers of 3rd–5th-grade students in participating schools were contacted to invite their classes to participate in data collection activities; six teachers at the intervention school and five at the comparison school volunteered. A survey was then administered to students in the participating classes at baseline and following completion of the *FTTF* pilot administration to capture information about dietary intake and psychosocial factors related to mindful and sustainable eating. No identifiable data, including demographics, were collected in the survey, and written parental consent was not required by the overseeing review board. Instead, study announcements were distributed to parents, and an assent script was read to students in these classes prior to data collection.

As intervention strategies were intended to reach the entire school rather than only students eating school-provided meals, students were eligible to complete the survey on the data collection day regardless of whether they ate a school-provided lunch or a meal brought from home. Willing students who were present on data collection days were administered a survey about fruit and vegetable intake and psychosocial factors related to MSE. Students at the comparison school received no study-related contact except for participation in the survey. The intervention school received the *FTTF* intervention and participated in the same survey.

FTTF is based on Social Cognitive Theory (SCT), which posits that dietary behavior can be explained by important SCT constructs, including self-efficacy, outcome expectations, knowledge, social support, modeling/observational learning, and availability of food (Bandura, 1986, 2004; Cerin et al., 2009). SCT emphasizes the concept of reciprocal determinism, where personal, behavioral, and environmental factors are interdependent (Bandura, 1986, 2004). Within SCT, knowledge is considered a necessary but insufficient factor to influence behavior; while increased knowledge is often correlated with improved behavioral outcomes, it might be more accurately considered an antecedent than a direct influence (Reynolds et al., 1999; Rolling & Hong, 2016).

The framework for *FTTF* was designed to depict hypothesized relationships between key influences, including self-efficacy, intentions, behavioral strategies, and perceptions of importance with mindful and sustainable eating. In the framework of reciprocal determinism, environmental and personal factors are thought to influence and be influenced by behavior (Reynolds et al., 1999). Based on this, the cafeteria component of *FTTF* was intended to provide reminders and reinforcements about study-related messages to help students learn and practice new skills. Similarly, peer influences and modeling opportunities have been demonstrated as successful approaches to influencing healthful nutrition behaviors and were considered instrumental in the design of *FTTF* (Rolling & Hong, 2016). The SCT-related constructs evaluated in the survey (self-efficacy, intentions, behavioral strategies, expectations, and perceptions of importance) can be considered personal factors and were targeted in the lessons provided to VLs (see Table 1). Based on our understanding of SCT, we also designed the FTTF intervention to target behavioral and environmental factors. By offering comprehensive MSE education to VLs, guiding them to create environmental reinforcements, and fostering peer leadership/observational learning opportunities, we aimed to improve personal factors related to MSE among the broader school community.

Evaluation

The survey used in this study was adapted from an SCT-oriented eating behavior survey to measure changes in MSE behaviors and food frequency items to capture the previous day's FV intake (Dewar et al., 2013; Kelder et al., 2005). Prior to use, the adapted survey was reviewed with subject-matter experts for face validity and tested with 50 3rd–5th-grade students for understandability. The original eating behavior survey showed good internal consistency (α = 0.65–0.79) and acceptable model fit with confirmatory factor analysis (Dewar et al., 2013). Adaptations were made to specifically target MSE behaviors based on a review of relevant literature. Items were rated on Likert-type scales using 4–6 response categories, and responses for each construct were averaged. Measured MSE constructs included self-efficacy to base lunch choices on body cues (4 items), intentions to select and eat healthy foods (4 items), behavioral strategies to practice MSE (4 items), expectation of health-related benefits from MSE (3 items), and importance of experiencing benefits from MSE (3 items). Three items measuring FV intake

(including fruits, vegetables, and beans in any form) were selected from an instrument with acceptable internal consistency ($\alpha > 0.6$; Kelder et al., 2005). Responses to FV intake items were summed, with values for each ranging from 0–3 times eaten the previous day. Selected items included in the survey are shown in Table 2.

Table 2. Selected MSE Questionnaire Items

Domain	Selected Items
Food Frequency Questionnaire	• Yesterday, did you eat any vegetables? Vegetables are salads; boiled, baked, and mashed potatoes; and all cooked and uncooked vegetables. Do not count French fries or chips. • Yesterday, did you eat fruit? Do not count fruit juice.
Self-efficacy to base lunch choices on body cues	When I eat lunch at school • I believe I can decide how much food is the right amount for me. • I find it difficult to eat an amount of food that's right for me when I eat with my friends.
Intentions to select and eat healthy foods	In the next three months, do you • intend to think about how hungry you are before eating lunch? • intend to think about how the foods you eat help or hurt the Earth?
Behavioral strategies employed to practice MSE behaviors	In the past three months, did you • think about how hungry you were before choosing food at lunch? • think about whether the foods you chose were good for you?
Expectations of health-related benefits resulting from MSE	Please indicate how much you agree or disagree with each statement. • My body gives me cues that help me decide what to eat. • Understanding where food comes from (how it is grown, produced, or made) helps me eat healthier.
Importance of experiencing expected benefits from MSE	• How important is listening to your body cues to you? • How important is understanding where food comes from to you?

Descriptive statistics were used to summarize sample characteristics and study variables. Because pre- and post-tests contained multiple-level categorical responses, the test of marginal homogeneity was used to compare the percentage of students who increased, decreased, or did not change ratings to evaluate within-group differences (Spears & Wilson, 2010). Percent change in ratings, calculated as ([follow-up rating - baseline rating]/follow-up rating) x 100, was used to summarize the overall patterns of each group. The *t*-test for independent samples was used to evaluate the percent change across schools for between-group differences; *p*-values < 0.05 were considered statistically significant. Analyses were performed using IBM SPSS (Version 24.0).

All procedures were approved by the University of Maryland College Park Institutional Review Board.

Results

The potential number of students was approximately 297 ($n = 162$ intervention, $n = 135$ comparison). For this study, a total of 169 students ($n = 102$ intervention, $n = 67$ comparison)

completed the survey at baseline and follow-up. Approximate response rates at the intervention and comparison schools were 63.0% and 49.6%, respectively. Changes in FV intake and MSE constructs are presented in Table 3.

At the intervention school, there was a significant change in self-efficacy to base lunch choices on body cues ($p = 0.005$), where 61.9% of students increased ratings following the intervention, and the overall percent change for all students was an increased rating of approximately 17.6%. No other significant within-school changes were observed. When considering between-school differences, there was a larger percent change in ratings from baseline to follow-up at the intervention school than at the control school for behavioral strategies to practice MSE (+7.5% at intervention vs. -4.90% at control, $p = 0.031$) and expectation of benefits from MSE (+13.34% at intervention vs. +0.14% at control, $p = 0.032$).

Table 3. Comparison of Between- and Within-group Percent Change in Reported Ratings for Dietary and Psychosocial Constructs among 3rd-5th Grade Students, Measured by MSE Behavioral Survey (n = 169)

Variable	Intervention School (n = 102)		Comparison School (n = 67)		Between Group *p* -value[1]
	Percent change (SD)	Within Group *p*-value[2]	Percent change (SD)	Within Group *p*-value[2]	
Produce intake	10.50 (90.0)	NS	11.3 (103.2)	NS	NS
Self-efficacy to base lunch choices on body cues	17.6 (49.1)	**.005**	5.64 (31.7)	NS	NS
Intentions to select and eat healthy cafeteria foods	4.02 (44.2)	NS	5.64 (31.7)	NS	NS
Behavioral strategies used	7.50 (39.0)	NS	-4.90 (28.5)	NS	**0.031**
Expectations of benefits	13.34 (40.7)	NS	0.14 (33.6)	NS	**0.032**
Importance of experiencing benefits	3.59 (24.13)	NS	0.37 (29.2)	NS	NS

Note. [1]Between-group comparison conducted using t-test for independent samples; [2]Within-group comparison conducted using test of marginal homogeneity

Discussion and Implications

Overall, the pilot implementation was successful in developing a feasible program to target the psychosocial constructs of students' MSE behaviors. Adapting existing resources from programs related to mindful eating or ecoliteracy enabled the development of an MSE curriculum tailored to elementary school students. Complementary strategies, including a menu highlighting daily FV options, labeling foods on the tray line, soliciting student feedback, and expanding the cafeteria share table to recover unwanted foods, offered opportunities for students to consider available choices and practice MSE skills. Improved ratings for some survey responses among intervention school students indicated that the program has the potential to improve self-efficacy

in practicing MSE. When comparing the two schools, students from the intervention school had larger increases in ratings for the behavioral strategies and expectations subscales. Furthermore, while the between-group difference did not reach significance, response trends for self-efficacy appeared more favorable at the intervention school (where more students increased or did not change their ratings) than in the comparison. Although few studies have specifically used mindful eating approaches to encourage waste reduction, our findings are similar to those of Bohme et al., who demonstrated that a short-term mindfulness intervention leads to increased awareness and perceived abilities related to sustainable consumption (Böhme et al., 2018). The changes that were observed in our study, specifically when considering changes in self-efficacy and behavioral strategies, may mean that students were able to develop practical skills related to MSE during the intervention. Future trials using a larger sample and longer duration will be useful to investigate these trends further.

Despite the small scope of this study, the design of the intervention was based on some foundational concepts examined elsewhere. Because the well-being of humans, communities, and environments are interdependent, this project was initially conceived to examine the amorphous connections between these systems. Past work has discussed the altruistic and empathetic characteristics of school-aged children and leveraged these characteristics to develop connections between children, nature, and local communities to promote pro-environmental behaviors (Cheng & Monroe, 2012; Goldberg et al., 2015; Goleman et al., 2012). Similarly, the overlap between nutrition and sustainability, while not a new concept, is a critically important area for ongoing exploration, and focusing on the intersection between these concepts is a promising avenue for food waste reduction (Prescott et al., 2019; Redman & Redman, 2014). Our study also emphasized the importance of peer influence and children as drivers of change, an approach used successfully in this arena previously and a strategy that we believe to be a valuable component of *FTTF* (Antón-Peset et al., 2021; Prescott et al., 2019).

It is important to acknowledge that the generalizability of study findings may be limited due to its focus on a small, rural school district encompassing only a few elementary schools, resulting in a relatively small sample size and a lack of geographic and racial/ethnic diversity among participants. Randomization of the participating schools was not feasible, and some baseline differences in survey responses at the two schools somewhat complicated the interpretation of survey results. Other challenges related to waste disposal and food recovery arose during our study. Attempting to expand an existing cafeteria-based composting program from another district school was impeded by the lack of a commercial composter in the rural area, and other options, such as on-site composting, were not feasible due to the small size and scale of this pilot implementation. We believe encouraging composting as an alternative waste disposal method would complement the goals of this study and is an important area for further work. While the food recovery component was small in scale, it effectively provided learning opportunities for students and demonstrated the potential for broader cafeteria-based food recovery initiatives in the future.

Based on the results of this study, we recommend ongoing work to expand and further evaluate *FTTF* approaches. To broaden the reach of *FTTF*, we suggest that researchers consider strategies not addressed due to logistical constraints, such as connecting with families, cafeteria composting, and school wellness policies. The adapted instrument would benefit from ongoing evaluation for reliability and validity in measuring psychosocial changes in this population. While this study focused on attitudes related to MSE, other outcomes such as plate waste (which will be reported in a future publication), satisfaction with school lunches, and knowledge related to MSE would also be useful in evaluating the program. Feasibility and acceptability were not systematically captured in this trial, and we recommend future studies assess these aspects further.

To balance waste reduction with nutritional goals, study findings support encouraging students to think about food choices in advance, the needs of their bodies and the planet, and sustainable waste disposal. *FTTF* offers a framework to address these considerations while positively impacting nutritional intake and reducing the environmental impact of school meals.

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