Early Childhood Education Journal (2020) 48:117–126
https://doi.org/10.1007/s10643-019-00962-4

A Mindfulness Intervention for Food Neophobia Among Preschoolers

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Published online: 18 July 2019

Abstract
Given the overlap between mindfulness and food neophobia, the current study developed and tested a mindfulness-based intervention to decrease food neophobia in preschoolers. Preschoolers (ages 3–5) participated in 10 sessions of a mindfulness intervention group (n = 27) or a food-exposure control group (n = 25). Children were assessed pre- and post-test on their ability to explore and describe novel foods and toys, as well as their willingness to try novel foods. Children in the intervention group used more senses to explore and more words to describe novel foods and toys at posttest compared to pre-test. At post-test, the intervention group used more senses to explore foods and more words to describe toys than the control group. No differences regarding willingness to try novel foods at post-test were observed. However, the intervention group tried novel foods willingly during mindful eating exercises. This intervention was enjoyed by childcare providers and children alike. Given the barriers to encouraging children to eat healthfully, this study highlights the potential for teachers and other childcare providers to incorporate such an intervention into their classrooms to encourage healthy eating habits and improve child health.

Keywords Mindfulness · Neophobia · Intervention · Preschool

In our current food climate, encouraging children to eat healthfully is both important and challenging. Notably, children in the United States (U.S.) often fail to eat recommended amounts and varieties of fruits and vegetables (Centers for Disease Control and Prevention 2014). One of the barriers to fruit and vegetable intake in children is food neophobia, defined as the avoidance or reluctance to eat novel foods (Dovey et al. 2008). This paper details a new mindfulness intervention for food neophobia that could be implemented in school and childcare settings to encourage healthy eating in young children.

Food Neophobia

Food neophobia, the initial rejection or avoidance of a new food (Lafraire et al. 2016), is common among young children and typically peaks between the ages of two and six and then declines throughout childhood and adolescence. Food neophobia has evolutionary significance because it supports the avoidance of foods that might be toxic or dangerous to consume (Dovey et al. 2008; Rozin 1990). Toxic foods usually have a bitter taste, as do many fruits and vegetables (Dovey et al. 2008). Due to this phenomenon, neophobia is a particular challenge to efforts to encourage children to eat more fruits and vegetables. Indeed, research has linked child food neophobia to low fruit and vegetable consumption in children in general (Wardle et al. 2005), and in those with an overweight body-mass index (BMI) (Kaar et al. 2016).

Although food neophobia in children is common, there are individual differences in levels of novel food avoidance, some of which can be linked to actions of important people in the child's life, such as parents, teachers, and peers. For example, studies have found that parent and child food neophobia were positively related (Kaar et al. 2016), and that mothers who were food neophobic and had food neophobic children were less likely to have healthy foods available for their children (Tan and Holub 2012).

In school and childcare settings, children's teachers and peers also appear to influence food neophobia. For example, several studies (e.g., Addessi et al. 2005; Hendy 2002) have found that children are more likely to try a new food if a peer eats the same food, especially if the peer is enthusiastic

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about eating the food (Hendy 2002). Enthusiastic teacher modeling is also effective for encouraging children to try new foods (Hendy and Raudenbush 2000). Because of the positive role that teachers and peers can play in encouraging children to try new foods, settings such as preschools are well suited to efforts to overcome food neophobia.

Existing Interventions for Food Neophobia

Several studies have examined techniques to decrease food neophobia in children. Early efforts to decrease food neophobia in children suggested that repeated exposure to novel foods increased preference for those foods (Birch and Marlin 1982). Birch and Marlin (1982) exposed young children (age 2) to novel cheeses and fruits over approximately 3 weeks. At the end of the study, the children preferred the novel foods they were exposed to more than those they were exposed to less frequently. Additional research suggests that repeated exposure to foods is most effective when children taste the food (Birch et al. 1987). In this study, children 2- to 5-years old were exposed to novel fruits by using only vision and olfaction (i.e., sense of smell) or using vision, olfaction, and taste. Only children whose exposure to the novel fruits included taste showed enhanced preference for the fruits at the end of the study (Birch et al. 1987). However, other studies have made arguments for visual exposure approaches as well (Heath et al. 2011; Houston-Price et al. 2009). For example, in one study, children exposed to picture books with visuals of fruits or vegetables everyday for 2 weeks were more willing to taste exposed foods, with stronger effects for foods that were unfamiliar or less liked (Houston-Price et al. 2009).

Other techniques have been compared to exposure-only or have been combined with exposure to successfully decrease food neophobia. For example, interventions using modeling and non-food rewards typically reduce food neophobia and increase the liking of foods compared to exposure-only control groups (Holley et al. 2015; Laureati et al. 2014). A school-based intervention called "Food Dudes" sought to increase fruit and vegetable consumption and decrease neophobia (Laureati et al. 2014). Children (ages 6 to 9) were assigned to either a control group (provided with fruits and vegetables) or an experimental group (watched motivational videos, read letters encouraging fruit and vegetable consumption, and received small non-food rewards for eating fruits and vegetables; Laureati et al. 2014). The experimental group showed lower levels of food neophobia and higher liking of fruits and vegetables than the control group at post-test. These findings remained at a 6-month follow-up with the exception of liking vegetables (Laureati et al. 2014). Similarly, a home-based intervention found that children (ages 2 to 4) in an intervention group including modeling, non-food rewards, and exposure to a non-liked vegetable consumed more vegetables and had an increased liking of vegetables post-intervention compared to an exposure-only control group (Holley et al. 2015). These programs demonstrate that multi-component intervention strategies can be more beneficial than exposure alone at decreasing neophobia and, in some cases, may have a long-lasting impact.

Furthermore, recent interventions have leveraged the use of sensory play in order to improve children's health food consumption and decrease food neophobia, given that sensory-based factors play a role in food neophobia (Coulthard et al. 2018; Dazeley and Houston-Price 2015; Hoppu et al. 2015). These programs have seen success in decreasing children's food neophobia and increasing their willingness to try novel fruits. Notably, an intervention by Coulthard et al. (2018) developed a 5-week sensory play-based intervention for preschoolers to increase fruit consumption. Children in the combined sensory play group (fruit and non-food) and the non-food sensory play group liked significantly more fruits at follow-up compared to a control play group. However, only children in the non-food sensory play group enjoyed fruits more compared to the other two groups. A review of strategies to improve children's eating behaviors (DeCosta et al. 2017) found that the strategy of sensory education led to at least a short term decrease in food neophobia. Taken together, this suggests that sensory awareness might be a promising component in food neophobia interventions, but the effectiveness of pairing sensory play with food is still unclear.

The above studies demonstrate some success in decreasing child food neophobia; however, there are still mixed conclusions as to which techniques work the best. The present study sought to capitalize on the benefits of taste exposure, modeling, and sensory awareness for reducing food neophobia, while incorporating a new approach that has gained traction in recent years: mindfulness.

Mindfulness and Health

Mindfulness is defined as paying attention to the present moment, in a nonjudgmental and purposeful fashion (Kabat-Zinn 1990). Mindfulness might be an effective tool to address child food neophobia, as greater mindfulness about new foods could reduce common barriers to trying them, including reducing a child's fear by building nonjudgmental awareness of new foods' sensory components. Mindfulness has been conceptualized as having five different facets: observing (noticing internal and external experiences), describing (labeling experiences with words), acting with awareness (attending to one's current experience), non-judgment towards inner experiences (experiencing thoughts and feelings without judgment), and non-reactivity towards inner

experiences (allowing the experience of thoughts and feelings without reacting to them; Baer et al. 2006).

Mindfulness has been related to a number of healthy eating behaviors. For example, adults who are more mindful tend to demonstrate reduced calorie consumption and healthier snacking (Jordan et al. 2014). A mindfulness-based eating awareness intervention, which exposed adult participants to a range of sensory-based eating and body meditations, was effective at improving weight loss and binge eating symptoms and severity (Kristeller et al. 2014), suggesting the sensory awareness component of mindfulness may be particularly relevant for eating behavior. Among adolescents, mindfulness is associated with lower consumption of food due to fatigue and boredom in the absence of hunger (Pivarunas et al. 2015). Research on mindfulness-based health interventions for youth suggests that mindfulness can improve health behaviors and related outcomes (Dalen et al. 2015), but this field of research remains quite limited, especially among young children.

Mindfulness Interventions for Health Behaviors Among Youth

Given the relation between mindfulness and eating behaviors across age groups, it follows that mindfulness interventions could improve such behaviors and related health outcomes. Several interventions have examined the impact of mindfulness on health and related cognitive processes. For example, research conducted on preschool children (ages 3 to 5) explored the effects of a mindfulness-based yoga intervention on promoting self-regulation (Razza et al. 2015). Children in the intervention group practiced yoga-related activities throughout the day in a year-long program and were assessed pre- and post-intervention on aspects of self-regulation such as effortful control (e.g., delayed gratification), executive functioning (e.g., inhibitory control), and attention. Children in the intervention group improved more on effortful control and executive functioning than children in the control group, and these improvements were particularly strong for individuals initially low in these constructs. Self-regulatory abilities are implicated in adults' eating behaviors and are thought to contribute to children's abilities to make appropriate eating decisions as well (Miller et al. 2015).

Furthermore, the program described above was found to be feasible to implement in a school setting for 11-year-old children (Bergen-Cico et al. 2015). The yoga and mindfulness concepts were integrated into the school's daily curriculum, the intervention was completed consistently, and the students overall enjoyed the content. In addition, a relatively small amount of class time was devoted to yoga-related activities (e.g., average of 4 min of meditation, three times per week), but the intervention group still exhibited improvements in self-regulation compared to the control group post-intervention. This suggests that even small amounts of mindfulness intervention can be successful for children when the content is incorporated over a long period of time within the class curriculum. However, further research is needed to explore similar interventions with preschool-aged children.

There remains a paucity of experimental research specifically focused on mindfulness interventions for eating behaviors, especially among preschool-aged children. One preliminary intervention conducted with six kindergarteners (ages 3 to 5) explored differential effects between an acceptance and commitment therapy (ACT)-based mindfulness intervention alone and the intervention accompanied by a behavioral reinforcement strategy to increase consumption of novel foods (Kennedy et al. 2014). Children in both groups were taught about and played games associated with mindfulness skills, such as self-as-context (e.g., labeling "I never eat this" as a thought), cognitive defusion, values, and committed action. Children in the ACT Plus group received an added emphasis on committed action to eat in alignment with their value of health through a reinforcement paradigm. The researchers' attempted to bridge the gap between eating behaviors in the moment and the long-term health outcomes associated with eating by providing the children with a reward when they ate any amount of a target food. This pilot study produced an increase in the percent of vegetables, fruits, and beans tasted during the ACT Plus component of the intervention but did not find the mindfulness intervention alone to effectively improve consumption of novel foods. While the sample was too small to make definitive inferences, these findings suggest that a mindfulness intervention has the potential to improve food neophobia when it includes other behavioral strategies (i.e., reinforcement).

Another school-based mindfulness intervention for ninth graders is currently underway and aims to improve health variables related to diet and physical activity (Salmoirago-Blotcher et al. 2015). Students in that study will be exposed to mindfulness training during their typical health education course, while the control group will receive the same dose of attention training. Proposed curriculum for the treatment group will focus on awareness of the breath, body scan exercises, and other activities for adolescents to experientially explore mindfulness concepts. Researchers are clearly gaining interest in the role mindfulness may play in improving youth health and eating behaviors. However, to the authors' knowledge, no studies to date have examined the impact of sensory awareness on eating behaviors or health outcomes among children. Further research on specific constructs of mindfulness and health behaviors is needed.

The present study created, implemented, and evaluated a mindfulness-based intervention to improve children's (ages 3 to 5) eating behaviors by decreasing food neophobia, based

on the available research on sensory awareness and food neophobia as well as that on mindfulness broadly and health behaviors. The effectiveness of a mindfulness intervention was compared to a more standard repeated exposure-only paradigm to decrease food neophobia. We paid particular attention to children's abilities to engage in mindfulness activities as well as the process of conducting such an intervention in preschools consistently.

Method

Participants

A convenience sample of four childcare centers were recruited via email and telephone from a rural town in northwest Ohio. Childcare centers were assigned to the intervention or exposure-only control group by order of receipt of consent (e.g., Center 1 and 2—intervention, Center 3 and 4—exposure-only). Childcare centers were assigned to either the intervention or exposure-only control group rather than individual children due to the group nature of the intervention activities. From these childcare centers, fifty-two preschoolers (ages 3 to 5; 60% male) were recruited via parent letters and in-person recruitment at pick-up times. The sample was primarily Caucasian (96.9%). Parents ($n=30$) completed online surveys about household demographics. Parents (87% mothers) reported that they worked full time (84%), had an Associate's degree or higher (62%), and had a household income of $80,000 or higher (56.3%). Twenty-seven children in two centers received the mindfulness intervention curriculum, and 25 children in two other centers received the exposure-only control curriculum. Bowling Green State University Institutional Review Board approved all procedures prior to recruitment.

Measures

Data were collected pre- and post-intervention for all children. In the first phase of assessment, the exploration phase, children were asked to explore (i.e., using different senses to discover an item) and describe (i.e., labeling the experience of exploring an item with words) two novel foods and two novel toys. Exploration was coded for number of senses used (i.e., taste, touch, smell, sight, hearing) and number of words used to describe each item. If the child tasted the food during their exploration, they were asked to rate how the food tasted using a facial scale (from very sad face to very happy face) where each face was assigned an anchor ranging from 1 *(really didn't like it)* to 5 *(really liked the food)*. In the second phase, the neophobia phase, children were asked if they would like to try six individually-presented foods [two familiar (1 fruit, 1 vegetable), four novel (2 fruit, 2 vegetable)]. Post-test assessment was structured similarly to pre-test. The only differences in pre-test and post-test assessments were the number of novel foods presented to the children. At post-test during the second phase, children were presented with two familiar foods (1 fruit, 1 vegetable), two previously novel foods presented at pre-test (1 fruit, 1 vegetable), and two novel foods (1 fruit, 1 vegetable). Height and weight were also measured at post-test.

Mindfulness Curriculum

Adapting mindfulness concepts for preschool-aged children, session content focused on teaching children to use their five senses to explore foods to increase awareness and non-judgment about food. For example, students explored and identified known foods with their eyes closed, using only their hands. Students also participated in four mindful eating exercises in the last four treatment sessions, in which they were guided through an experiential script and asked to use all of their senses to explore a food item and eat it slowly. Other session content included learning where foods grow to increase their awareness of, and connection with, the food they consume and the earth, as well as deep breathing exercises to encourage present-centered awareness. All activities were interactive, either in a group format or one-on-one with student co-leaders. Some activities were adapted from existing materials (e.g., Greenland 2010; Kluge 2015). See Table 1 for brief descriptions of each session.

Procedures

All children participated in the pre-intervention assessment individually. Children gave assent and were taken to a quiet area of the classroom. After the assessment, children were thanked for their participation, given a sticker, and returned to normal classroom activities.

Children in the intervention group received ten sessions of a mindfulness-based curriculum focused on teaching them to use their five senses to explore food and participating in mindful eating exercises featuring both novel and familiar foods (e.g., raisins, banana chips, bamboo shoots, dried figs). Ten sessions were delivered over 5 weeks (two sessions per week). Two trained female researchers led each session. Activities lasted 15 to 30 min and were conducted either individually or as a group depending on the activity. When each session was complete, children returned to normal classroom activities.

Children in the exposure-only control group received ten sessions of exposure to a novel food and a fun activity. Ten sessions were delivered over 5 weeks (two sessions per week). Two trained female researchers led each session. For the exposure portion, children were presented the same novel food, a radish, at each session. Children were told,

Table 1 Mindfulness curriculum by session

Session	Activities	Brief description
1	Noticing the senses	Facilitators discussed the senses and practiced noticing something for each sense in the environment
	What's in the box?[a]	One child attempted to identify a fruit hidden in a box by touch alone and described it to other children in the group using guided questions (e.g., what does it feel like, think it looks like, hard or soft)
2	Food touch discovery[a]	Each child attempted to identify three foods hidden in boxes by touch alone. Facilitators used guided questions when necessary (e.g., what does it feel like, think it looks like, hard or soft)
3	Sorting beans[a]	Each child was individually blindfolded and asked to sort six beans (three different types, two of each type). Facilitators discussed the importance of sight as well as other senses in eating and identifying items
4	Where did it come from?[a]	Children viewed a PowerPoint to show how (e.g., in the ground, on stalks) and where (e.g., geographically) food grows, and what foods look like as they grow. Facilitators and children acted out harvesting ripe foods and eating those foods. *Take-home handout*: "Where did it come from?" featuring different foods than session foods for parents to discuss with their children
5	Smell me! What am I?[b]	Children smelled items (e.g., tea bags, wax melts) and attempted to match smells to images (Ex: Cinnamon tea = apple pie image, vanilla wax melt = ice cream). Facilitators discussed the importance of smell in exploring of and eating of food. *Take-home handout:* "Exploring Smells" encouraged children to draw an object with a noticeable scent
6	Sounds of the kitchen	Children listened to audio clips of kitchen activities and attempted to guess what the activity was. Facilitators discussed the importance of sounds when cooking, exploring food, and eating. *Take-home handout*: "Helping in the Kitchen" demonstrated ways parents can engage children when cooking
7	Eating mindfully[a]	Children mindfully ate a raisin while guided by facilitators. Facilitators discussed the benefits of mindful eating. *Take-home handout:* "Mindfully Eating with Your Child" demonstrated how parents might encourage their children to each mindfully
8	Eating mindfully[a]	Children mindfully ate banana chips while guided by facilitators. Facilitators discussed the benefits of mindful eating
	Deep breathing	Facilitators guided deep breathing meditation by having children place a stuffed animal on their chests and rock it to sleep with their breathing
9	Eating mindfully[a]	Children mindfully ate bamboo shoots while guided by facilitators. Facilitators discussed the benefits of mindful eating
	Deep breathing	Facilitators guided deep breathing meditation by having children imagine holding a cup of hot chocolate and having to carefully blow on it to cool it down. *Take-home handout:* "Hot Cocoa Breathing" demonstrated the hot cocoa method for deep breathing
10	Eating mindfully[a]	Children mindfully ate dried figs while guided by facilitators. Facilitators briefly reviewed all sessions

[a]Adapted from Greenland (2010)

[b]Adapted from Kluge (2015, October 22)

"This is a radish. You can try it if you want, but you don't have to if you don't want to." After a few minutes, children were then invited to participate in a fun activity (e.g., Simon Says, Freeze Dance). When each session was complete, the children returned to normal classroom activities. After ten sessions, all children in both groups were given a post-intervention assessment. Parents of the children who participated in the study received a small gift equivalent to about $5 (US).

Data Analysis

Paired samples *t* tests compared pretest scores to post-test scores on the following dimensions of the assessment: number of senses used to explore foods, number of senses used to explore toys, number of descriptive words for foods, number of descriptive words for toys, number of foods tasted during the exploration phase of the assessment, number of foods tasted during the neophobia phase of the assessment, and the average rating of foods that were tasted.

To identify if exposure-only control and intervention groups were initially different, independent samples t-tests comparing the pretest scores between the intervention and exposure-only control group were conducted. Significant differences were found between the intervention and exposure-only group on four dimensions: the number of senses used to explore a food (Intervention > exposure-only; $p < .01$), number of foods tasted during the exploration phase (Intervention > Exposure-only; $p < .05$), number of foods tasted during the neophobia phase (Intervention > exposure-only; $p < .01$), and number of descriptive words for food (Intervention < exposure-only; $p < .05$). Thus, pretest scores were controlled for in subsequent analyses.

Mixed model analyses were conducted to compare post-test scores between the intervention group and the control group while controlling for pre-test scores and nesting data within preschools. Nesting data to account

for non-independence of participants produces more conservative estimates of standard error for significance testing; therefore, the procedure outlined by O'Dwyer and Parker (2014) was utilized.

Results

Pretest to Post-test Comparisons for Intervention Group

Number of Senses Used

The number of senses used to explore foods and toys were summed across the two foods (possible score = 0–10) and two toys (possible score = 0–10). Children who received the intervention used significantly more senses to explore foods at post-test ($M = 5.19$, $SD = 1.60$) than at pretest [$M = 3.96$, $SD = 1.75$; $t(25) = -3.26$, $p < .01$], as well as to explore toys at post-test ($M = 4.23$, $SD = .65$) than at pretest [$M = 3.84$, $SD = .61$; $t(25) = -2.30$, $p < .05$].

Number of Descriptive Words Used

Composite scores were created by summing the number of descriptive words used across both foods and then again for both toys. Children who received the intervention used significantly more descriptive words for foods at post-test ($M = 2.36$, $SD = 1.64$) than at pretest [$M = 1.21$, $SD = .93$; $t(25) = -3.67$, $p < .01$], as well as for toys at post-test ($M = 3.01$, $SD = 1.60$) than at pretest [$M = 1.96$, $SD = 1.54$; $t(25) = -3.21$, $p < .01$].

Number of Foods Tasted During the Exploration Phase of the Assessment

Composite scores were created by summing the number of foods children tasted at pre- and post-test (total possible = 2). Children who received the intervention did not significantly differ in the number of foods tasted from pretest ($M = .85$, $SD = .88$) to post-test [$M = 1.08$, $SD = .89$; $t(25) = -1.56$, $p = .17$].

Foods Tasted During the Neophobia Phase of the Assessment (Number and Rating)

Composite scores were created by summing the number of foods children tasted at pre- and post-test (total possible = 6). There was no difference in the number of foods tasted between pretest ($M = 3.76$, $SD = 2.32$) and post-test [$M = 3.15$, $SD = 2.30$; $t(25) = -1.25$, $p = .22$]. Composite scores of children's ratings of foods tasted at pre- and post-test were created by taking the average of children's food ratings (higher scores indicate increased favorability) across the foods that were tasted during the assessment. Children rated the foods they tasted more favorably at pretest ($M = 3.61$, $SD = 1.16$) than at post-test [$M = 2.65$, $SD = 1.33$; $t(17) = 3.15$, $p < .01$].

Pretest to Post-test Comparisons for Exposure-Only Control Group

Number of Senses Used

The number of senses used to explore foods and toys were summed across the two foods (possible score = 0–10) and two toys (possible score = 0–10). Children who were in the exposure-only control group used significantly more senses to explore foods at post-test ($M = 3.50$, $SD = 1.47$) than at pretest [$M = 2.83$, $SD = .87$; $t(23) = -2.44$, $p = .02$], as well as to explore toys at post-test ($M = 4.29$, $SD = .46$) than at pretest [$M = 4.00$, $SD = .42$; $t(23) = -2.29$, $p = .03$].

Number of Descriptive Words Used

Composite scores were created by summing the number of descriptive words used across both foods and then again for both toys. Children who were in the exposure-only control group used significantly *fewer* descriptive words for foods at post-test ($M = 1.23$, $SD = .81$) than at pretest [$M = 1.71$, $SD = .81$; $t(23) = 2.79$, $p = .01$], and did not use significantly more descriptive words for toys from pretest ($M = 2.35$, $SD = .79$) to post-test [$M = 2.27$, $SD = 1.33$; $t(23) = .34$, $p = .73$].

Number of Foods Tasted During the Exploration Phase of the Assessment

Composite scores were created by summing the number of foods children tasted at pre- and post-test (total possible = 2). Children who were in the exposure-only control group did not significantly differ in the number of foods tasted from pretest ($M = .38$, $SD = .71$) to post-test [$M = .50$, $SD = .83$; $t(23) = -.72$, $p = .48$].

Foods Tasted During the Neophobia Phase of the Assessment (Number and Rating)

Composite scores were created by summing the number of foods children tasted at pre- and post-test (total possible = 6). There was no difference in the number of foods tasted between pretest ($M = 2.25$, $SD = 1.96$) and post-test [$M = 2.54$, $SD = 2.08$; $t(23) = -.92$, $p = .37$]. Composite scores of children's ratings of foods tasted at pre- and post-test were created by taking the average of children's food ratings (higher scores indicate increased favorability)

across the foods that were tasted during the assessment. There was no difference in how children rated the foods they tasted between pretest ($M = 3.91$, $SD = 1.02$) and post-test [$M = 3.53$, $SD = 1.23$; $t(16) = 1.22$, $p = .24$].

Intervention to Exposure-Only Group Comparison

Exploring and Describing

After nesting for preschool and controlling for pretest scores, a mixed model analysis using the number of senses children used to explore food at post-test found significant differences between the intervention group and the exposure-only control group [$F(1, 33.83) = 4.27$, $p < .05$, $\eta^2 = .14$]. The intervention group used significantly more senses to explore foods at post-test ($M = 5.19$, $SD = 1.60$) than the exposure-only control group ($M = 3.50$, $SD = 1.47$). A second mixed model analysis using the number of descriptive words children used to describe toys revealed that the intervention group used more descriptive words ($M = 3.02$, $SD = 1.61$) than the exposure-only control group ($M = 2.27$, $SD = 1.33$), which trended towards significance [$F(1, 46) = 3.156$, $p = .08$, $\eta^2 = .11$]. Both of these mixed model analyses yielded medium effect sizes.

Tasting During the Assessments

Mixed model analyses using the number of foods tasted during both the exploration and neophobia phases of the post-test did not reveal any significant differences between the groups. The intervention group was not more likely to try a novel food during the describe phase ($M = 1.08$, $SD = .89$) than the exposure-only control group [$M = .50$, $SD = .83$, $F(1, 2.67) = .42$, $p = .57$]. Additionally, the intervention group was not more likely to try a novel food during the neophobia phase at post-test ($M = 3.15$, $SD = 2.31$) than the exposure-only control group [$M = 2.54$, $SD = 2.08$, $F(1, 6.77) = .81$, $p = .40$]. Likewise, the remaining dimensions of the post-test assessment (e.g., number of descriptive words for food, number of senses used to explore toy, average rating of foods tasted) did not reveal any significant differences between the intervention group and the exposure-only control group.

Tasting During the Intervention

During the last four intervention sessions, children were guided through a script in which the goal was to mindfully eat a food. Two sessions featured familiar foods (e.g., raisins and banana chips) and two sessions featured novel foods (e.g., bamboo shoots and dried figs; chosen to be novel, but still palatable to the children). Post hoc field notes indicated that the majority of children in the intervention group tried both novel and familiar foods when using a mindful eating approach. Children in the exposure-only control group were presented with radishes at all ten sessions; field notes indicate that most children in the exposure-only control group chose not to try the radishes during the post-test sessions. This is consistent with a pretest to post-test comparison using only the exposure-only control group. Two paired samples t-tests found that children in the exposure-only control group were not more likely to try a novel food during the exploration phase from pretest to post-test [$t(23) = -1.00$, $p = .33$] or during the neophobia phase from pretest to post-test [$t(25) = -1.25$, $p = .22$].

Conclusion

Overall, this novel mindfulness-based intervention to improve children's eating behaviors by decreasing food neophobia showed great promise. Field notes indicate that both childcare center personnel and children themselves found the activities to be enjoyable. Furthermore, children in the mindfulness group used more senses to explore foods and more words to describe foods at post-test than the exposure-only control group. This suggests that children's mindfulness skills improved slightly over the course of the intervention and may have decreased some aspects of food neophobia.

Children who experienced the 10-week mindfulness intervention used more senses to explore foods at post-test, suggesting greater sensory awareness was a beneficial outcome of the intervention. Consistent with these findings, other research has suggested that a brief mindfulness intervention with undergraduate students was associated with increased sensory enjoyment of eating, and increased sensory enjoyment mediated the relationship between mindfulness and lower caloric consumption of "junk" foods (Arch et al. 2016). However, there appear to be mixed findings on the link between sensory exploration and food neophobia with young children (e.g., benefits of food sensory play above non-food sensory play; Coulthard et al. 2018). Perhaps sensory exploration does not precipitate eating behavior change among young children. It is also possible that more exposure to sensory-based mindfulness exercises is needed for the effects to take form in children's behaviors and habits. Given the sparsity of research in this area, it is worth noting that the methodology used here appears to have been a valid means of assessing some aspects of mindfulness in preschool aged children behaviorally. More longitudinal research is needed to continue exploring these variables amongst young children.

In addition to improved sensory exploration, children in the intervention group demonstrated improved skills at describing a toy. Greater attention to and descriptions of an object may reflect greater mindfulness among preschool

aged children. To the authors' knowledge, there is no literature on the use of the described skill of mindfulness and associated health outcomes, especially in young children. Thus, this topic warrants further exploration to examine the validity of assessing specific skills in young children as indicators of mindfulness, as well as research on the link between specific skills and positive outcomes. It is unclear why greater ability to describe items for children in the intervention was not associated with tasting more foods. It is possible that description in the context of mindfulness is more influential when paired with nonjudgmentalness, as it is the ability to describe something without negative perceptions that would more likely lead to less judgmental awareness of novel foods for young children. Future research should aim to examine how nonjudgmentalness could be incorporated into a mindfulness curriculum for young children.

Despite improvements in exploration and description skills, children in the intervention group were not more likely to try a food at post-test than those in the exposure-only control group. This is an area for further intervention program development. In the current intervention, six of the ten sessions did not involve tasting foods and concentrated instead on sensory exploration and description. However, children were very willing to try new foods during the sessions that included mindful eating exercises. Future iterations of the program should emphasize mindfully tasting new foods to allow children to practice applying those skills to eating. Furthermore, future explorations should also examine if mindful eating skills persist long-term in preschoolers, as the current program only evaluated mindfulness skills immediately post-intervention. Finally, given the increased willingness to try foods that the children demonstrated during the mindful eating exercises, future research should formally explore how a mindful approach to presenting novel foods to children might impact children's willingness to try new foods.

Limitations and Future Directions

Though promising, this study has important limitations. The sample size of the study was small. Although there was sufficient power to detect medium effect sizes, future studies should consider recruiting more children for a more robust test of hypotheses. Another limitation of this study is that due to real-life constraints of childcare center schedules, there was day-to-day variation in the structure of the sessions, (e.g., sessions were sometimes conducted outside or in a different classroom). Furthermore, schools, not children, were assigned to either the intervention or exposure-only control group. In the future, children should be randomized within centers, which might yield clearer results regarding the effectiveness of such an intervention.

In addition to the above recommendations, future interventions may benefit from incorporating the content within the school curriculum and for a longer period of time throughout the year. With the mindful yoga intervention for preschoolers, infusing the content within the curriculum was thought to be a major benefit to the program (Bergen-Cico et al. 2015). In addition to improving the consistency of curriculum delivery, this might have the added benefit of regular classroom teachers leveraging the trust that their students already feel for them to encourage healthier eating habits. An 8-week mindfulness intervention for preschool teachers examined the effect teacher training had on their students (Singh et al. 2013). Teachers were taught a new meditation technique each week and were asked to apply it into their classroom curriculum. Despite a small sample size of only three teachers and 18 students, the authors found that students' challenging behaviors decreased, compliance with requests increased, negative interactions decreased, and neutral interactions increased. This study illuminates the potential benefit of including teachers in such interventions, as they are likely to exert additional positive influence on students.

While the current study did not include an assessment of caregiver involvement (e.g., sending home information and activities for parents to reinforce the concepts at home), future studies should investigate the additional improvement such involvement might bring. Caregiver mindfulness is related to youth mindfulness and health behaviors, suggesting that modeling and exposure to adults with related skills can positively influence youth. For example, higher levels of mindful parenting are associated with more positive parenting practices (Parent et al. 2016). Furthermore, mindful feeding, or feeding one's children with awareness and while centered in the present moment, predicts increased fruit and vegetable consumption and decreased added sugar consumption (Emley et al. 2017).

Compliance with Ethical Standards

Conflict of interest This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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