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## Pediatric Weight Management Interventions Improve Prevalence of Overeating Behaviors

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### Abstract

**Objective:** To examine changes in prevalence of overeating behaviors in a comparative effectiveness study of two pediatric weight management interventions.

**Methods:** Four-hundred and seven children, ages 6–12 years, with a BMI 85<sup>th</sup> percentile were enrolled in a comparative effectiveness trial of two pediatric weight management interventions. Prevalence of ‘sneaking, hiding or hoarding food’, and ‘eating in the absence of hunger’ was evaluated at baseline and 12 months. Statistical methods included McNemar’s test and longitudinal logistic regression.

**Results:** Prevalence of ‘sneak, hide, or hoard food’ significantly decreased in all participants from 29.1% to 20.7% at 12 months. The prevalence of ‘eating in the absence of hunger’ decreased

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**Contributions**

LF and ET were involved in all parts of the study, including study concept and design, obtaining funding, data collection, analysis, and writing of manuscript; MP was involved in administrative, technical, and material support of the study as well as design of the analysis; ML conducted the data analysis, SGH and SP, KBM, HC, IC, and BR were involved in the data analysis plan development and execution, and manuscript preparation; all authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

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**Clinical Trial Registration:** This trial has been registered at [ClinicalTrials.gov](https://clinicaltrials.gov) (identifier: NCT03012126)

in all participants from 46.7% to 22.4% at 12 months. Use of SNAP benefits, free/reduced meals at school, parental stress, housing and food insecurity at baseline were associated with an increased likelihood of endorsing overeating behaviors at 12 months. Conversely, those who engaged in at least one session of the pediatric weight management intervention were significantly less likely to endorse 'eating in the absence of hunger' at 12 months.

**Conclusions:** Participation in pediatric weight management interventions improves the prevalence of overeating behaviors and is associated with participant engagement and social determinants of health, specifically food security status. Efforts to engage populations impacted by food insecurity and other social determinants of health risk factors will be critical for success of weight management interventions.

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## Introduction

Obesity continues to be a widespread disease in the United States with a significant burden of morbidity in childhood and adolescence, which persists through adulthood.<sup>1,2</sup> Obesity is associated with long- and short-term health conditions including but not limited to cardiovascular disease, hypertension, and type 2 diabetes, demonstrating the importance of intervention and prevention efforts in youth.<sup>3</sup> There is increasing evidence demonstrating a greater involvement of social determinants of health risk factors among individuals with overweight or obesity and their dietary intake patterns and behaviors.<sup>4,5</sup> More specifically, low-income households often experience food insecurity defined as limited or no access to safe and nutritious food, resulting in a suboptimal diet.<sup>6,7</sup> Furthermore, coping with food insecurity often includes greater intake of low-cost fast foods, with bingeing when resources are readily available.<sup>8</sup> The social stressors associated with food insecurity have been shown to influence dietary intake behaviors such that studies in food-insecure adults and children have described binge-type eating patterns, food hiding, and night time eating episodes.<sup>8-11</sup> Given the shared risk factors among obesity, food insecurity, and disordered eating behaviors, interventions to prevent and manage obesity should address all to best identify barriers to change and optimize intervention efficacy. However, evaluation of weight management interventions for treatment of overweight/obesity that integrate efforts to address both social determinants of health risk factors and disordered eating behaviors are lacking.

The current study sought to expand the literature by (1) evaluating eating in the absence of hunger and sneaking/hiding/hoarding food prevalence over the course of two pediatric weight management interventions in children with obesity, and (2) identify demographic and modifiable lifestyle behaviors that may contribute to the prevalence and endorsement of these overeating behaviors. We hypothesized that pediatric weight management interventions could reduce the prevalence in overeating behaviors.

## Methods

### Study design and participants

The current study was part of the Clinic and Community Approaches to Healthy Weight study, which is described in greater detail elsewhere.<sup>12</sup> Briefly, it was a two-arm trial in

two communities in Massachusetts that serve a large population of low-income children and families. The two-arm trial compared the effects of two Healthy Weight Clinics (HWC) versus a modified Healthy Weight and Your Child program at the YMCA (M- HWYC) among children who were six to 12 years old with a body mass index (BMI) 85<sup>th</sup> percentile. Each of the two intervention groups received an intensive six month intervention, followed by a six month maintenance intervention that delivered 30 hours of contact time over the one-year intervention period consistent with the current USPSTF guidelines to provide 26 hours of contact time.<sup>2</sup> Briefly, within the HWC, visits alternated between group visits with other children and families in the program and individual visits for the first six months and in the second six months visits were individual. Topics covered in the group visits included: understanding health, healthy eating, healthy drinks, physical activity, bullying, sleep and screens, reading food labels and eating out of the home. Additional support was provided by bi-weekly phone calls during the first six months, and monthly phone calls in the second six months. Conversely, the M-HWYC program included 16 weekly sessions, followed by four sessions delivered every other week and concluded with five monthly sessions, for a total of 25 in-person sessions. Sessions were two hours in length and include a group of about 8–15 children and their caregivers. Each session included goal setting and action planning, a parent discussion, and 60 minutes of physical activity for the children the last 30 minutes of which was for the whole family.<sup>12</sup>

Parents of study participants were surveyed at baseline (enrollment in the program) and after six, and 12 months from first program interaction through a phone-based interview. Surveys were conducted by trained research assistants and parents received a \$25 gift card for survey participation. All study activities were approved by the Institutional Review Board at the Massachusetts Department of Public Health and Mass General Brigham. The trial has also been recorded in the [clinicaltrials.gov](https://clinicaltrials.gov) national registry of randomized trials. We obtained informed consent from the parents/guardians for all participants.

### Independent variables

Baseline demographic data included participant age, sex, race/ethnicity, and BMI parameters (BMI, BMI z-score, % of the 95<sup>th</sup> percentile for BMI, and BMI category). Parent characteristics at baseline included race/ethnicity, born outside of U.S., education level, and parent BMI (categorically defined as lean or overweight/obesity). Additional parental characteristics included parental stress defined by the single-item question “stress means a situation in which a person feels tense, restless, nervous, or anxious or is unable to sleep at night because his or her mind is troubled all the time. Do you feel this kind of stress these days?” with a positive response as “rather much” or “very much”;<sup>13,14</sup> and parental depression defined by a positive response to the single-item question “Did you ever see a health care professional who said that you were depressed?”.<sup>15</sup>

Household characteristics included family food assistance enrollment (Woman, infants, & children (WIC) benefits, and Supplemental Nutrition Assistance Program (SNAP)); use of free/reduced meals at school; annual household income at baseline; housing insecurity defined by a positive response to the following questions drawn from the National Survey of America’s Families 2002 Questionnaire:<sup>16</sup> (1) During the last 12 months, was there a time

when you and your family were not able to pay your mortgage, rent or utility bills? And (2) During the last 12 months, did you or your children move in with other people even for a little while because you could not afford to pay your mortgage, rent or utility bills?; and food insecurity defined by a positive response to one of the following two questions of the Hunger Vital Sign™:<sup>17</sup> (1) Within the past 12 months we worried whether our food would run out before we got money to buy more; (2) Within the past 12 months the food we bought just didn't last and we didn't have money to get more.

The median and IQR for contact hours were 3.0(0–7.7) in the HWC, 5.0(0–16) in the M-HWYC, and 3.0(0–10) when combined and previously reported.<sup>15</sup> Given these values, and the context provided by Nobles et al. denoting an engagement pathway, or “extent to which, and how, individuals participate in weight management services,” which is best captured as any involvement in the intervention, we categorized the engagement variable as attended at least one visit (yes/no) at 12 months.<sup>18</sup> For the categorical variable attendance adherence, the cut-off of attending greater than or equal to 5 visits has been previously published and endorsed by the Center for Disease Control.<sup>19</sup>

Healthy lifestyle continuous independent variables were measured at baseline and 12 months and are presented as change in fast food intake (servings/week), all sugary beverage intake (servings/week), sleep (hours/day), screen time (hours/day), and physical activity (days/week).

### Outcome Measures

Overeating behaviors were captured by parental endorsement of the following two questions. These two pulled questions have been asked in childhood obesity trials and the endorsement of these overeating behaviors was found to be prevalent in a similar population of children.<sup>20</sup>

1. Does your child ever sneak, hide, or hoard food?<sup>21</sup>
2. Does your child ever eat large amounts of food, even when he or she is not hungry?<sup>22,23</sup>

The presence or absence of each overeating behavior was evaluated at baseline and 12 months.

### Statistical Analyses

Baseline demographic characteristics were compared across intervention groups (M- HWYC vs. HWC) using a one-way analysis of variance, Kruskal-Wallis test, or Chi square test. Prevalence of overeating behaviors at baseline and 12 months was evaluated by McNemar's test. Longitudinal logistic regression was used to determine whether overeating behavior endorsement was associated with our independent variables of interest summarized above. Analyses used a complete case analysis, where 77 of 407 observations were dropped for missing data for the outcome or covariates of interest resulting in a sample size of 330. All models were adjusted for time (baseline vs. 12 months). Models were initially also adjusted for intervention arm; however, this was not significantly associated and was therefore not

included as a covariate in subsequent models. Statistical analyses were carried out using SAS 9.4 (Cary, NC). Significance determined at  $p < 0.05$ .

## Results

Baseline demographic characteristics were similar across groups (all participants, HWC, and M-HWYC) and summarized in Table 1. In both communities, the participant population was predominantly Hispanic (93%), 69% of families made less than \$20,000 per year, and 44% of parents had less than a high school degree. Among all parents, 30.5% reported high levels of parental stress. In comparison, parental depression was significantly different by intervention arm, with 41.8% and 30.6% reporting depression in the HWC and M-HWYC, respectively. On average at baseline about 50% of the participants were food insecure, and 30% were housing insecure, with approximately 25% of participants enrolled in WIC, approximately 68% enrolled in SNAP, and over 86% receiving free/reduced meals at school. Across both interventions, greater than 62% of participants engaged in at least one visit.

There was no effect of intervention arm on ‘sneak, hide, or hoard food’ (OR 0.98, CI 0.64–1.51,  $p = 0.83$ ) and ‘eating in the absence of hunger’ (OR 0.92, CI 0.62–1.36,  $p = 0.66$ ). Thus, for all subsequent analyses, intervention stratification was collapsed. Prevalence of ‘sneak, hide, or hoard food’ significantly decreased in all participants from 29.1% at baseline to 20.7% at 12 months of follow up. The prevalence of ‘eating in the absence of hunger’ decreased in all participants from 46.7% at baseline to 22.4% at 12 months of follow up (Table 2).

Upon examining the association between ‘sneak, hide, or hoard food’ and various categorical variables (Table 3), the significant independent categorical variables were enrollment in SNAP benefits and free/reduced meals at school at baseline. Such that individuals were about two times more likely at 12 months to endorse ‘sneak, hide, or hoard food’ if enrolled in SNAP benefits at baseline (OR 1.89, CI 1.17–3.04) versus those that were not enrolled. Similarly, individuals were approximately three times more likely to endorse ‘sneak, hide, or hoard food’ if receiving free/reduced meals at school (OR 2.71, CI 1.26–5.83) compared to those who were not receiving free/reduced meals.

The associations between ‘eating in the absence of hunger’ and the various categorical variables are presented in Table 4. The association between ‘eating in the absence of hunger’ and engagement was inversely related, such that participants who attended at least one session were 62% less likely to endorse ‘eating in the absence of hunger’ (OR 0.38, CI 0.17–0.82) compared to participants who did not attend any session. Parents who reported high levels of stress at baseline were 69% more likely to endorse ‘eating in the absence of hunger’ (OR 1.69, CI 1.11–2.56) compared to parents who did not report high levels of stress. Of the categorical household characteristics, housing insecurity and food security were associated with ‘eating in the absence of hunger’. Families that were housing insecure were 1.67 times more likely to endorse ‘eating in the absence of hunger’ compared to those that were housing secure (OR 1.67, CI 1.09–2.55). Similarly, families that were food insecure were two times more likely to endorse ‘eating in the absence of hunger’ compared to those that were food secure (OR 1.95, CI 1.32–2.89).

The significant association between healthy lifestyle change independent variables and both overeating behaviors over time was fast food intake (servings/week) such that for every additional serving of fast food, participants were 23% more likely to endorse ‘sneak, hide, or hoard food’, and 24% more likely to endorse ‘eating in absence of hunger’ (Table 5). Additionally, we observed a significant association between screen time and endorsement of ‘eating in the absence of hunger’, such that for every additional hour of screen time, participants were 7% more likely to endorse ‘eating in the absence of hunger’.

## Discussion

In a two-arm trial of pediatric weight management interventions delivered in a clinic and community setting, we found that the prevalence of ‘sneak, hide, or hoard food’ and ‘eating in the absence of hunger’ significantly decreased in all participants at 12-months of follow-up, demonstrating the efficacy of pediatric weight management interventions in mitigating overeating behaviors. Our results showed that enrollment in SNAP and receiving free/reduced cost meals at school, increased the odds of overeating behaviors compared to those not utilizing these programs. Parent and household characteristics that were identified as significantly associated with overeating behavior endorsement included high levels of parental stress, housing insecurity, and food insecurity. Conversely, engagement in the pediatric weight management intervention contributed to a significant reduction in overeating behavior endorsement compared to those who never engaged.

Our findings are consistent with the literature suggesting a link between food insecurity and overeating behaviors. Food insecurity is thought to drive cycles of restriction and over consumption, even when the restriction is externally driven rather than internally imposed for weight control.<sup>10,24–26</sup> In particular our finding that SNAP enrollment and free/reduced meals at school were associated with a higher likelihood of endorsing overeating behaviors may speak to the cyclical restriction related to monthly distribution of these funds altering meal size, frequency, and quality which may facilitate recurrent binge-like eating patterns and increase risk of weight gain.<sup>11,27–29</sup> Our findings speak to the dynamic and complex construct of food insecurity, which is influenced by poverty, unemployment, disability, and race/ethnicity. Food insecurity affects a greater proportion of racial/ethnic minorities and socially disadvantaged populations that are already at an increased risk of diet related diseases including obesity, diabetes, and heart disease.<sup>30</sup> Federal programs including SNAP, WIC and the National School Lunch Program, as well as community based food banking systems have been found to improve access and availability of healthy foods, and ultimately improve both adult and child health and well-being.<sup>31–33</sup> Given our findings and the current literature, strategies for better food insecurity support, such as increasing monthly fund allotment, and linkages to effective pediatric weight management interventions will benefit from mutual consideration. However, we must consider future efforts that focus on the root cause of poverty and economic hardship that will contribute to ongoing federal food assistance success.

Similarly, housing insecurity is also a risk factor for various health outcomes, including childhood obesity.<sup>34–36</sup> The financial and emotional pressures of food and housing insecurity, as well as other factors contribute to parental stress and poor mental health.

Multiple studies have found an association between maternal stress or depression and child obesity, and that maternal stress in combination with food insecurity negatively impacts a child's weight status.<sup>37–41</sup> Additionally, parental stress can lead to weight gain through stress-induced hormonal and metabolic changes in conjunction with unhealthy eating behaviors and physical inactivity.<sup>42,43</sup> There is also evidence demonstrating that poor parental mental health and food insecurity result in unhealthy feeding practices, such as providing fast food, and poor parenting practices, such as increased screen time, both of which we observed in this study, that can influence a child's weight and promote overeating behaviors.<sup>43–47</sup> Our findings demonstrate that consideration of a family's food and housing security status and parental stress may be helpful in the context of childhood obesity and understanding drivers of overeating behaviors.

In pediatric weight management studies, attendance adherence is associated with improved short-term and long-term outcomes including weight loss and maintenance.<sup>48–53</sup> Our study builds upon these findings and has demonstrated the role of engagement in mitigating overeating behaviors. We found that participants who attended at least one session were significantly less likely to endorse 'eating in the absence of hunger' from baseline to 12 months.<sup>54</sup> Interaction with program providers may help reduce weight stigma and also aid in the development of healthy lifestyle changes targeted within the program (i.e. portion control, diet quality, physical activity, sleep, and screen time) that could be contributing to the decrease in overeating behavior endorsement.

Several factors may affect the generalizability of our study results. First the study design did not include direct measures of participant engagement in the healthy lifestyle behaviors outside of the pediatric weight management interventions, such as activity monitors to capture physical activity or dietary recalls to capture intake, which may be a stronger mediator contributing to decreased endorsement of binge eating symptoms. Other methods to consider for future studies may include self-monitoring log completion or home food environment assessments. Next, the overeating behaviors were captured by report of parent's response of "yes" to two questions, highlighting the possibility of parental reporting bias of children's behavior. In addition, these two items came from larger questionnaires with subscales that we did not administer in their entirety due to participant burden from the larger randomized controlled trial survey questions. Overeating behaviors were not indicative of binge eating behaviors which would be better captured by the Eating Disorder Examination-Questionnaire<sup>55</sup> and the Binge Eating Scale<sup>56</sup> and inclusion of loss of control questions which is required for binge eating disorder diagnosis using the *DSM-5* criteria. We did not include loss of control measure due to various reports in pediatric populations that highlight overeating rather than loss of control, making it harder to interpret due to developmental factors.<sup>57</sup> Additionally, binge eating diagnosis and/or associated psychiatric comorbidities were not clinically confirmed. Strengths of our study include a large community-based cohort, and evaluation of multiple possible determinants of overeating behaviors in a predominantly Latino, low-income population.

## Conclusion

We demonstrated that pediatric weight management interventions can reduce endorsement of overeating behaviors which has significant public health and clinical practice implications. The results support the need for improved assessment and monitoring used in both clinical and community settings to evaluate overeating behaviors, in combination with screening for food security and adequate food assistance despite families being enrolled on SNAP or using free/reduce cost meals at school. Considering a family's socioeconomic status and its greater implications on family dynamics including parental stress, may be vital in understanding the context of pediatric obesity and determining more effective interventions.

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## Abbreviations:

<b>BMI</b>	Body Mass Index
<b>HWC</b>	Healthy Weight Clinics
<b>M-HWYC</b>	Healthy Weight and Your Child program at the YMCA
<b>SNAP</b>	Supplemental Nutrition Assistance Program
<b>WIC</b>	Woman, Infants, & Children

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**Table 1.**

Participant and parent baseline characteristics in the Clinic and Community Approaches to Healthy Weight Study

	<b>Total</b>	<b>HWC</b>	<b>M-HWYC</b>	
	<b>N = 407</b>	<b>N = 201</b>	<b>N = 206</b>	
<b>Participant characteristics</b>	<b>Mean (SD)</b>			<b>P value</b>
Age, years	9.58 (1.83)	9.57 (1.88)	9.60 (1.78)	0.88
BMI z-score	1.95 (0.45)	1.95 (0.46)	1.95 (0.45)	0.90
BMI, kg/m <sup>2</sup>	25.0 (4.90)	25.1 (5.03)	24.9 (4.79)	0.82
% of the 95 <sup>th</sup> percentile for BMI	113.4 (19.31)	113.7 (19.60)	113.1 (19.07)	0.80
	<b>N (%)</b>			
Sex, female	183 (45.0)	89 (44.3)	94 (45.6)	0.78
<b>BMI category</b>				
Overweight	109 (26.8)	54 (26.9)	55 (26.7)	0.98
Obesity	176 (43.2)	86 (42.8)	90 (43.7)	
Severe Obesity	122 (30.0)	61 (30.3)	61 (29.6)	
Race/Ethnicity, Hispanic	377 (92.9)	186 (92.5)	191 (92.7)	0.67
<b>Parent characteristics</b>				
Parents Born Outside of U.S.	145 (35.7)	74 (36.8)	71 (34.6)	0.65
<b>BMI category</b>				
Lean	64 (17.1)	31 (17.0)	33 (17.1)	0.99
Overweight/obesity	311 (82.9)	151 (83.0)	160 (82.9)	
<b>Education</b>				
Less than High School	177 (43.9)	84 (42.4)	93 (45.4)	0.55
High School Graduate	132 (32.8)	70 (35.4)	62 (30.2)	
Some College or More	94 (23.3)	44 (22.2)	50 (24.4)	
<b>Annual income</b>				
Less than \$20,000/year	218 (68.6)	101 (63.9)	117 (73.1)	0.10
More than \$20,000/year	100 (31.4)	57 (36.1)	43 (26.9)	
<b>Parental Stress, % yes</b>	124 (30.5)	60 (29.9)	64 (31.1)	0.79
<b>Parental Depression, % yes</b>	147 (36.1)	84 (41.8)	63 (30.6)	0.02
<b>Housing Insecurity, % yes</b>	121 (29.7)	59 (29.4)	62 (30.1)	0.87
<b>Food Insecurity, % yes</b>	200 (49.1)	93 (46.3)	107 (51.9)	0.25
<b>Family food assistance enrollment</b>				
WIC (Woman, Infants, & Children), % yes	104 (25.6)	54 (26.9)	50 (24.3)	0.55
Supplemental Nutrition Assistance Program, % yes	280 (68.8)	137 (68.2)	143 (69.4)	0.78
Free/reduced meals at school, % yes	360 (88.5)	182 (90.5)	178 (86.4)	0.19

<sup>a</sup>Parents born outside of U.S. n=406, n=1 missing.

<sup>b</sup>Education, n=403, n=4 missing.

**Table 2.**

Prevalence of overeating behaviors among participants in the Clinic and Community Approaches to Healthy Weight Study by site and from baseline to 12 months of follow-up.

Overeating behaviors	Baseline	Baseline (with follow-up at 12 month)	12 months	
	N = 407	N = 330	N = 330	
	N (%)			<i>P</i> value <sup>a</sup>
Child sneak, hide or hoard food. (Yes)	119 (29.2)	96 (29.1)	68 (20.7)	0.003
Eating in the absence of hunger. (Yes)	190 (46.7)	154 (46.7)	74 (22.4)	<0.001

<sup>a</sup> unadjusted p-value from baseline to 12 months follow up.

<sup>b</sup> Data analyzed by McNemar's test

**Table 3.**Associations between ‘child sneak, hide, or hoard food’ endorsement and categorical variables<sup>a</sup>

Categorical variables	Baseline	12 months	OR (95% CI)
	N = 330 <sup>c</sup>		
<b>Sex</b>			
Male	57 (31.2)	41 (22.5)	1.29 (0.84, 1.98)
Female	39 (26.5)	27 (18.4)	1.00 [ref]
<b>Baseline BMI category</b>			
Obesity	43 (28.7)	30 (20.0)	1.01 (0.60, 1.72)
Severe Obesity	31 (32.6)	19 (20.2)	1.13 (0.63, 2.01)
Overweight	22 (25.8)	19 (22.4)	1.00 [ref]
<b>Engagement</b>			
Attended at least 1 session	75 (31.4)	49 (20.6)	1.25 (0.77, 2.03)
Did not attend any session	21 (23.1)	19 (20.9)	1.00 [ref]
<b>Attendance adherence</b>			
Greater than 5 visits	36 (29.8)	26 (21.7)	1.07 (0.69, 1.66)
Less than 5 visits	60 (28.7)	42 (20.1)	1.00 [ref]
<b>Education level<sup>d</sup></b>			
Some high school or less	47 (33.1)	28 (19.7)	1.14 (0.75, 1.76)
High school graduate or more	49 (26.3)	40 (21.6)	1.00 [ref]
<b>Annual income<sup>e</sup></b>			
\$20,000 or less	61 (33.5)	43 (23.6)	1.54 (0.89, 2.66)
More than \$20,000	22 (28.6)	10 (13.0)	1.00 [ref]
<b>Parental Stress</b>			
Yes	35 (34.7)	19 (18.8)	1.16 (0.74, 1.83)
No	61 (26.6)	49 (21.5)	1.00 [ref]
<b>Parental Depression</b>			
Yes	42 (36.2)	26 (22.4)	1.44 (0.93, 2.24)
No	54 (25.2)	42 (19.7)	1.00 [ref]
<b>Housing Insecurity</b>			
Yes	35 (36.8)	20 (21.1)	1.36 (0.86, 2.15)
No	61 (26.0)	48 (20.5)	1.00 [ref]
<b>Food Insecurity</b>			
Yes	51 (31.3)	35 (21.6)	1.18 (0.77, 1.81)
No	45 (26.9)	33 (19.8)	1.00 [ref]
<b>Family food assistance enrollment</b>			
<b>WIC</b>			
Yes	29 (34.1)	15 (17.6)	1.08 (0.67, 1.75)
No	67 (27.3)	53 (21.7)	1.00 [ref]

Categorical variables	Baseline	12 months	OR (95% CI)
	N = 330 <sup>c</sup>		
<b>SNAP</b>			
Yes	72 (32.4)	54 (24.4)	<b>1.89 (1.17, 3.04)</b>
No	24 (22.2)	14 (13.0)	1.00 [ref]
<b>Free/reduced meals at school</b>			
Yes	91 (31.6)	63 (22.0)	<b>2.71 (1.26, 5.83)</b>
No	5 (11.9)	5 (11.9)	1.00 [ref]

<sup>a</sup>Data are presented as (N(%)). The percentages are row percent.

<sup>b</sup>Data analyzed by longitudinal logistic regression.

<sup>c</sup>Bolded values indicate significant odds ratios (OR).

**Table 4.**Associations between 'eating in the absence of hunger' endorsement and categorical variables<sup>a</sup>

Categorical variables	Baseline	12 months	OR (95% CI)
N = 330			
<b>Sex</b>			
Male	85 (46.4)	42 (23.0)	1.02 (0.69, 1.51)
Female	69 (46.9)	32 (21.8)	1.00 [ref]
<b>Baseline BMI category</b>			
Obesity	68 (45.3)	34 (22.7)	1.09 (0.67, 1.77)
Severe Obesity	48 (50.5)	23 (24.2)	1.28 (0.75, 2.18)
Overweight	38 (44.7)	17 (20.0)	1.00 [ref]
<b>Engagement</b>			
Attended at least 1 session	124 (51.9)	52 (21.8)	<b>0.38 (0.17, 0.82)</b>
Did not attend any session	30 (33.0)	22 (24.2)	1.00 [ref]
<b>Attendance adherence</b>			
Greater than 5 visits	58 (47.9)	31 (25.6)	1.18 (0.79, 1.77)
Less than 5 visits	96 (45.9)	43 (20.6)	1.00 [ref]
<b>Education level<sup>c</sup></b>			
Some high school or less	63 (44.4)	36 (25.4)	1.02 (0.69, 1.51)
High school graduate or more	90 (48.4)	38 (20.4)	1.00 [ref]
<b>Annual income<sup>d</sup></b>			
\$20,000 or less	85 (46.7)	44 (24.2)	1.02 (0.62, 1.67)
More than \$20,000	39 (50.6)	15 (19.5)	1.00 [ref]
<b>Parental Stress</b>			
Yes	58 (57.4)	27 (26.7)	<b>1.69 (1.11, 2.56)</b>
No	96 (41.9)	47 (20.5)	1.00 [ref]
<b>Parental Depression</b>			
Yes	57 (49.1)	28 (24.1)	1.17 (0.78, 1.76)
No	97 (45.3)	46 (21.5)	1.00 [ref]
<b>Housing Insecurity</b>			
Yes	53 (55.8)	27 (28.4)	<b>1.67 (1.09, 2.55)</b>
No	101 (43.0)	47 (20.0)	1.00 [ref]
<b>Food Insecurity</b>			
Yes	88 (54.0)	47 (28.8)	<b>1.95 (1.32, 2.89)</b>
No	66 (39.5)	27 (16.2)	1.00 [ref]
<b>Family food assistance enrollment</b>			
<b>WIC</b>			
Yes	33 (38.8)	18 (21.2)	0.74 (0.47, 1.16)
No	121 (49.4)	56 (22.9)	1.00 [ref]



Categorical variables	Baseline	12 months	OR (95% CI)
	<b>N = 330</b>		
<b>SNAP</b>			
Yes	106 (47.7)	54 (24.3)	1.25 (0.82, 1.91)
No	48 (44.4)	20 (18.5)	1.00 [ref]
<b>Free/reduced meals at school</b>			
Yes	133 (46.2)	65 (22.6)	0.94 (0.52, 1.67)
No	21 (50.0)	9 (21.4)	1.00 [ref]

<sup>a</sup>Data are presented as (N(%)). The percentages are row percent.

<sup>b</sup>Data analyzed by longitudinal logistic regression.

<sup>c</sup>Bolded values indicate significant odds ratios (OR).

**Table 5.**

Associations between overeating behaviors and continuous healthy lifestyle exposures from baseline to 12 months of follow up.

	'Child sneak, hide or hoard food'	'Eating in the absence of hunger'
Continuous variables	OR (95% CI)	OR (95% CI)
Fast food, servings per week	<b>1.23 (1.05, 1.43)</b>	<b>1.24 (1.06, 1.44)</b>
All sugary beverages, servings/week	1.03 (0.96, 1.10)	0.99 (0.93, 1.06)
Sleep, hours/day	1.09 (0.93, 1.27)	0.97 (0.84, 1.11)
Screen time, hours/day	1.06 (0.99, 1.14)	<b>1.07 (1.00, 1.15)</b>
Physical activity, days/week	0.97 (0.89, 1.06)	0.93 (0.86, 1.01)

<sup>a</sup>Data analyzed by longitudinal logistic regression.

<sup>b</sup>Bolded values indicate significant odds ratios (OR).