






Caregiver-reported household food insecurity and child-reported food insecurity in relation to eating disorder risk factors and symptoms among preadolescent children

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Abstract

Objective: To examine the relation of caregiver-reported household food insecurity (FI) and child-reported FI with eating disorder (ED) risk factors and symptoms, including effect modification by gender, in preadolescent children.

Method: Data were from the Family Food Study, a cross-sectional study of households with incomes $\leq 200\%$ of the federal poverty line in southeastern Michigan. Children aged 8–10 years ($n = 194$) and their female primary caregivers reported separately on FI status. Children reported ED risk factors/symptoms via the 24-item Children's Eating Attitudes Test (ChEAT-24), with higher scores indicating more ED risk factors/symptoms. Linear mixed models were used to examine associations between FI measures with the ChEAT-24 total score, plus subscale scores for dieting, food preoccupation, weight preoccupation, vomiting, and social pressure to eat/gain weight. Models were adjusted for child age, child gender, caregiver race/ethnicity, caregiver education, and household income.

Results: Among all children, child-reported FI, but not caregiver-reported household FI, was associated with more ED risk factors/symptoms. Child-reported FI (vs. no FI) was associated with higher average ChEAT-24 total score ($\beta = 2.41$, 95% CI: 0.57, 4.25). Child-reported FI was also associated with more food preoccupation, more weight preoccupation, and more social pressure to eat. Caregiver-reported household FI was marginally associated with less dieting in girls, and child-reported FI was associated with more dieting in boys.

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Discussion: Child-reported FI may be more salient than caregiver-reported household FI as a risk factor for ED-related outcomes in preadolescent children. Gender may modify the association between FI and dieting behavior.

Public Significance Statement: More child-reported food insecurity, but not parent-reported household food insecurity, was associated with more eating disorder risk factors and symptoms among preadolescent boys and girls. These findings emphasize the need for future studies that investigate the role of food insecurity in the development of eating disorders, especially studies that measure child-reported experience of food insecurity.

KEYWORDS

children, feeding and eating disorders, food insecurity, gender identity

1 | INTRODUCTION

Preadolescence (i.e., the developmental stage immediately preceding adolescence, from approximately 8–11 years of age) may be a critical period for the prevention of eating disorders (EDs). While the median age of onset for full-syndrome EDs is in mid-to-late adolescence (Hanson et al., 2007), proximal risk factors (e.g., body weight and shape concerns, dieting, and so forth) and subthreshold behavioral symptoms (e.g., fasting, purging, binge eating, and so forth) frequently emerge in preadolescence (Bernier et al., 2010; Combs et al., 2013; Swanson et al., 2014). Preadolescent children with ED risk factors/symptoms are more likely to develop full-syndrome EDs compared to preadolescents without ED risk factors/symptoms (McClelland et al., 2020; Swanson et al., 2014). Subthreshold ED symptoms are also associated with increased risk of several health and developmental concerns later in life, such as more psychological distress, worse self-rated health, more binge drinking and drug use, and metabolic syndrome, to name a few (Kärkkäinen et al., 2018; Swanson et al., 2014; Tanofsky-Kraff et al., 2012). A better understanding of the etiology of ED risk factors/symptoms in preadolescence is urgently needed to inform prevention efforts that can be implemented before prolonged disordered eating and/or ED onset occur. However, little is known about how environmental factors, such as the home food environment, are related to ED risk factors/symptoms in preadolescent children.

Exposure to food insecurity is one factor that might increase the risk for ED-related outcomes among preadolescents. Food insecurity (FI) is defined as a lack of sufficient financial resources to obtain enough quality food (Anderson, 1990). In 2020, approximately one in six U.S. children lived in food insecure households (Coleman-Jensen et al., 2021). There are multiple mechanisms through which FI might increase the risk for ED-related outcomes in children. First, worry about FI might directly increase food preoccupation. Indeed, an association between FI (vs. no FI) and more food preoccupation has been found in some studies of adults (Barry et al., 2021; Poll et al., 2020). In addition, FI might also increase ED risk indirectly through several possible pathways: FI (vs. no FI) in preadolescence has been associated with elevated depressive symptoms (Thomas et al., 2019) and greater

adiposity in children (Burke et al., 2016; Jansen et al., 2017; Lee et al., 2018). Experiences of household FI are also associated with some parental attitudes and behaviors, like more concern about child weight and more use of restrictive and pressured feeding practices (Bauer et al., 2015; Conlon et al., 2015). In turn, the aforementioned child and parental characteristics have been associated with greater likelihood of various ED risk factors/symptoms in children/adolescents, including dieting/food restriction, concern about body weight/body dissatisfaction, use of extreme weight control behaviors (which can include self-induced vomiting), and higher scores on scales of overall disordered eating (Jendryca & Warschburger, 2016; Larsen et al., 2015; Loth et al., 2014; Stice et al., 2011).

Preadolescents could be especially sensitive to the negative consequences of FI. While in the midst of a critical period for the development of eating habits and body image, preadolescents are also old enough to be cognizant of FI in the home (Fram et al., 2011; Leung et al., 2020). However, few studies have investigated this association in samples that include preadolescents: Masler et al. (2021) found that adult-reported household FI (vs. no FI) was associated with more weight loss attempts and unhealthy weight control behaviors in a sample of children aged 8–15 years. Another study by Altman et al. (2019) found that children in grades 4–8 (approximate ages 9–14) with self-reported FI were more likely to experience body dissatisfaction compared to those with no FI. While both of these studies included preadolescent children, the wide age ranges did not allow for specific examination of this key developmental window.

In addition, previous research suggests that while child and caregiver reports of FI are correlated, FI reports may disagree for over one-third of child-caregiver pairs (Bernard et al., 2018; Carlos Chavez et al., 2017). Although adult-reported household FI is the most commonly used method of assessing FI in the literature, child self-report more accurately reflects children's perceptions and experiences of FI (Fram et al., 2013). Understanding whether caregiver and child report of FI differ in their relationship to ED risk factors/symptoms is important for informing future research and FI assessment methods for both FI and ED prevention/intervention efforts. However, to the best of our knowledge,

previous studies on the association between FI and ED risk factors/symptoms have not included measures of both caregiver- and child-reported FI.

Finally, women have a higher lifetime prevalence of EDs compared to men (Hudson et al., 2007); there is also evidence that more FI is related to higher weight among girls but not boys (Burke et al., 2016; Jansen et al., 2017), and one study found that while more FI is associated with more ED risk factors/symptoms in both adult males and females, the association is stronger for males (Barry et al., 2021). Understanding whether gender modifies the associations between FI and ED-related outcomes in preadolescents may inform how potential FI and ED prevention/intervention programs could be targeted to the subgroups of children who would benefit the most. Yet, to the best of our knowledge, only one study has examined gender differences in the association between FI and ED-related outcomes in preadolescents. This previous study found that the association between FI and body dissatisfaction did not vary by sex (Altman et al., 2019).

Therefore, the goal of the present study is to assess the association of caregiver-reported household FI and child-reported FI with ED risk factors/symptoms, including the potential modifying role of gender, among preadolescent children.

2 | METHODS

2.1 | Participants

This study uses cross-sectional data from baseline assessments in the Family Food Study (FFS) that were conducted from September 2018 to December 2019. The FFS is a cohort of children aged 8–10 years at baseline, and their female primary caregivers. Families from southeastern Michigan with household incomes $\leq 200\%$ of the federal poverty line whose primary spoken language was English were recruited to participate via convenience sampling through the University of Michigan Health Research website, social media outreach, and flyer posting in neighborhood community centers. More than one child per household could participate when multiple children were age-eligible. Data collection occurred in participants' homes, where children and their female primary caregivers completed various assessments, including anthropometric measures, cognitive tasks, and in-depth survey questionnaires. The study focused on female caregivers because they generally report greater awareness of the household food environment and FI than male caregivers (Flagg et al., 2014; Nagao-Sato et al., 2021). All measures used in this study were collected through computer-based surveys that were self-administered separately by children and caregivers. Children were encouraged to ask trained staff members for assistance as needed, which included clarifying the meaning of questions and providing reading assistance for younger children. Caregivers provided written informed consent and children verbally assented to participate in the study. Female primary caregivers were compensated \$30 (U.S. dollars), and children received small toy prizes. This study was approved by the University of Michigan Medical School Institutional Review Board.

2.2 | Measures

2.2.1 | Food insecurity

Household FI was reported by female primary caregivers using the 18-item United States Department of Agriculture (USDA) Household Food Security Survey Module (Economic Research Service, 2012), which is known to have excellent validity and reliability (Marques et al., 2015). This survey asked questions about the household's ability to afford food over the previous 12 months and how the ability to afford food affected the quality or quantity of food available to children and adults in the household. Responses were scored on a scale of 0–18, where higher scores equate to more FI. Scores were grouped into two categories: no household FI (score 0–2) and household FI (score ≥ 3) (ERS, 2012). Household FI indicates that the food quality and/or quantity in the household is impaired due to lack of money to buy food (ERS, 2012). In our sample, internal consistency measured by Chronbach's α was .91 for the USDA Household Food Security Survey Module, which is consistent with previous studies (Marques et al., 2015).

Children reported their food security status via the five-item Child Food Security Assessment (CFSA), which is validated for use in children as young as 6 years old (Fram et al., 2013). This survey asked about the child's experiences related to FI, such as worry about getting enough food to eat or experiencing hunger because there is not enough food to eat. Children reported how frequently they had these experiences by choosing “never,” “sometimes,” or “a lot.” Responses were scored on a scale of 0–10, where higher scores equate to more FI. Consistent with a previous study, scores were also grouped into two categories: no child-reported FI (score 0–1) and child-reported FI (score ≥ 2) (Landry et al., 2019b). Chronbach's α for the CFSA was .73 in our sample.

2.2.2 | ED risk factors/symptoms

ED risk factors/symptoms were self-reported by children using the Children's Eating Attitudes Test (ChEAT) (Maloney et al., 1988). This questionnaire is designed to capture ED risk factors/symptoms among children 8–13 years old (Maloney et al., 1988). Children reported how frequently they experienced different risk factors/symptoms using six response options that each equated to a numeric score ranging from 0 to 3: “never” (score of 0), “rarely” (0), “sometimes” (0), “often” (1), “very often” (2), or “always” (3). Response scores were summed to produce a total ChEAT score for each child. The reliability and validity of the ChEAT have been shown in various studies (Lommi et al., 2020; Maloney et al., 1988; Rojo-Moreno et al., 2011; Smolak & Levine, 1994). Consistent with previous research, responses for two of the original 26 ChEAT items were dropped from this study: #19 (“I can show self-control around food”) and #25 (“I enjoy trying new rich foods”) (Lommi et al., 2020; Maloney et al., 1988; Murphy et al., 2019; Smolak & Levine, 1994). The resulting ChEAT-24 total score had a possible range of 0–72, where higher scores indicate more

TABLE 1 Questionnaire items from the original 26-item Children's Eating Attitudes Test (ChEAT-26)^a that comprise the ChEAT-24 and each of the ChEAT subscale scores^b

Item ^c		Subscale (possible score range)				
		Dieting (0–9)	Food preoccupation (0–9)	Weight preoccupation (0–9)	Vomiting (0–6)	Social pressure (0–9)
1	I am scared about being overweight			X		
2	I stay away from eating when I am hungry					
3	I think about food a lot of the time		X			
4	I have gone on eating binges where I feel that I might not be able to stop		X			
5	I cut my food into small pieces					
6	I am aware of the energy (calorie) content in foods that I eat	X				
7	I try to stay away from foods such as breads, potatoes, and rice					
8	I feel that others would like me to eat more					X
9	I vomit after I have eaten				X	
10	I feel very guilty after eating					
11	I think a lot about wanting to be thinner			X		
12	I think about burning up energy (calories) when I exercise					
13	Other people think I am too thin					X
14	I think a lot about having fat on my body			X		
15	I take longer than others to eat my meals					
16	I stay away from foods with sugar in them	X				
17	I eat diet foods	X				
18	I think that food controls my life		X			
20	I feel that others pressure me to eat					X
21	I give too much time and thought to food					
22	I feel uncomfortable after eating sweets					
23	I have been dieting					
24	I like my stomach to be empty					
26	I have the urge to vomit after eating				X	

^aThe ChEAT-26 was designed by Maloney et al. (1988).

^bChEAT subscales recommended by Murphy et al. (2019).

^cItem numbers based on order numbers from the original ChEAT-26. ChEAT-26 items 19 and 25 are excluded from the ChEAT-24.

ED risk factors/symptoms. In the present sample, Chronbach's α was .74 for the ChEAT-24.

To examine specific ED risk factors/symptoms, we also used a set of continuous ChEAT subscale scores recommended by Murphy et al. (2019): dieting, food preoccupation, weight preoccupation, vomiting, and social pressure to eat or gain weight. The questionnaire items that comprise the ChEAT-24 and its subscales, as well as possible ranges for the subscale scores, are shown in Table 1.

2.2.3 | Covariates

Children self-reported their age and gender. Female primary caregivers reported their own race/ethnicity, highest level of education,

annual household income, and the number of people in their household. Household income and household size were used to calculate the percentage of the poverty line based on the United States Department of Health and Human Services (HHS) Federal Poverty Guidelines for 2019 (Department of Health and Human Services, 2019).

2.3 | Statistical analysis

For survey measures with multiple items, participants who did not complete all items were considered missing for that measure. Children with non-missing data for at least one FI exposure and at least one ChEAT-24 measure (total score or a subscale score) were included in the analysis. Only one child was excluded due to missing data for all

ChEAT-24 measures. Among the analytic sample of 194 children, there were no children with missing data for caregiver-reported household FI, child-reported FI, or covariates. The number of children with non-missing data for each outcome were as follows: ChEAT-24

total score, 186; dieting subscale, 192; food preoccupation subscale, 193; weight preoccupation subscale, 194; vomiting subscale, 192; and social pressure subscale, 193. The analytic sample came from 166 households: 139 households with one participating child,

TABLE 2 Sociodemographic characteristics by 24-item Children's Eating Attitudes Test (ChEAT-24) total score and ChEAT subscale scores among preadolescent children aged 8–10 years old from low-income households in southeastern Michigan

	N ^a	Percentage	ChEAT-24 Total score		Dieting subscale		Food preoccupation subscale		Weight preoccupation subscale		Vomiting subscale		Social pressure subscale	
			Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Overall	194	100	5.2	6.2	0.8	1.3	0.8	1.5	1.1	2.1	0.2	0.7	0.5	1.6
Child age (years)														
8 ^b	66	34.0	4.6	6.5	0.5	1.0	1.1	1.8	0.6	1.4	0.2	0.8	0.4	1.4
9	72	37.1	4.8	4.8	0.8	1.3	0.5	0.9	1.4	2.2	0.2	0.8	0.4	1.1
10 ^c	56	28.9	6.4	7.4	1.0	1.5	0.7	1.5	1.5	2.6	0.1	0.5	0.8	2.2
<i>p</i> ^d			.24		.11		.08		.02		.71		.31	
<i>p</i> , trend ^e			.11		.04		.11		.01		.42		.19	
Child gender														
Boy	90	46.4	5.0	6.5	0.7	1.3	0.7	1.2	1.1	2.1	0.1	0.5	0.7	1.9
Girl	104	53.6	5.3	6.0	0.8	1.3	0.8	1.7	1.1	2.2	0.2	0.8	0.4	1.3
<i>p</i>			.72		.63		.61		.97		.39		.28	
Caregiver race/ethnicity														
White	115	59.3	4.4	5.5	0.6	1.1	0.7	1.5	1.0	2.1	0.1	0.7	0.4	1.3
Caregiver of color ^f	79	40.7	6.4	7.1	1.0	1.5	0.8	1.5	1.3	2.2	0.2	0.7	0.7	2.0
<i>p</i>			.04		.03		.75		.34		.58		.15	
Caregiver education														
≤High school diploma	31	16.0	4.3	5.5	0.8	1.2	0.8	1.6	1.1	2.1	0.3	0.9	0.4	1.1
Some college	100	51.6	5.9	7.3	0.7	1.3	0.7	1.6	1.3	2.2	0.1	0.6	0.6	1.8
≥Bachelor's degree	63	32.5	4.4	4.4	0.8	1.4	0.8	1.3	0.9	1.9	0.2	0.8	0.5	1.4
<i>p</i>			.23		.91		.93		.38		.54		.69	
Household income (% of poverty line) ^g														
<50	43	22.1	6.5	6.4	1.3	1.6	1.0	2.0	1.1	2.0	0.3	0.9	0.7	1.5
50 to <100	48	24.7	6.0	7.5	0.8	1.4	0.6	1.1	1.4	2.1	0.1	0.8	0.8	1.9
100 to <150	53	27.3	4.9	6.4	0.6	1.1	0.7	1.6	1.2	2.3	0.2	0.7	0.5	1.8
≥150	50	25.8	3.7	4.2	0.5	1.0	0.7	1.2	0.9	2.0	0.0	0.3	0.2	0.9
<i>p</i>			.16		.03		.75		.67		.22		.34	
<i>p</i> , trend			.03		.004		.61		.51		.07		.11	
Caregiver-reported household food insecurity														
No food insecurity	78	40.2	5.2	5.5	0.8	1.2	0.7	1.2	1.0	2.0	0.2	0.8	0.4	1.2
Food insecurity	116	59.8	5.2	6.7	0.7	1.3	0.8	1.6	1.2	2.2	0.2	0.6	0.6	1.8
<i>p</i>			.98		.55		.69		.46		.74		.30	
Child-reported food insecurity score														
0	39	20.1	4.0	5.7	0.8	1.3	0.2	0.6	0.9	2.0	0.2	0.9	0.4	1.4
1	45	23.2	3.9	4.1	0.8	1.2	0.6	1.2	0.7	1.7	0.1	0.5	0.3	1.4
2–3	51	26.3	4.9	6.2	0.6	1.1	0.5	1.0	1.3	2.2	0.2	0.6	0.5	1.4
4–5	29	15.0	7.4	5.8	0.5	1.1	1.9	2.0	1.9	2.8	0.2	0.7	0.4	1.1
6–10	30	15.5	7.0	8.8	1.2	1.8	1.0	2.1	1.1	1.9	0.2	0.8	1.3	2.4

(Continues)

TABLE 2 (Continued)

	N ^a	Percentage	ChEAT-24 Total score		Dieting subscale		Food preoccupation subscale		Weight preoccupation subscale		Vomiting subscale		Social pressure subscale	
			Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
<i>p</i>			.04		.24		<.001		.17		.95		.09	
<i>p</i> , trend			.005		.63		<.001		.12		.73		.03	

Abbreviation: SD, standard deviation.

^aDue to missing values, *n* varied for each outcome. Among the total analytic sample of 194 children, the specific *n* values for each outcome were as follows: ChEAT-24 total score, 186; dieting subscale, 192; food preoccupation subscale, 193; weight preoccupation subscale, 194; vomiting subscale, 192; social pressure subscale, 193.

^bIncludes two children who were 7 years old.

^cIncludes two children who were 11 years old.

^dBased on *F* test from unadjusted linear mixed models where the sociodemographic characteristic was modeled categorically and ChEAT total and subscale scores were modeled as continuous outcomes. Models accounted for clustering of children within the same households.

^eBased on Wald test from unadjusted linear mixed models where the sociodemographic characteristic was modeled ordinally and ChEAT total and subscale scores were modeled as continuous outcomes. Every model included a random intercept for household identifier to account for clustering of children within the same households.

^fAmong the 79 children with a caregiver of color, 53 (67.1%) had a Black/African American caregiver, three (3.8%) had a Hispanic caregiver, one (1.3%) had a Middle Eastern/North African caregiver, two (2.5%) had an Asian caregiver, 11 (13.9%) had a multi-racial/multi-ethnic caregiver, and nine (11.4%) had a caregiver of other race/ethnicity.

^gBased on the U.S. Department of Health and Human Services (DHHS) Federal Poverty Guidelines for 2019 (Department of Health and Human Services, 2019).

26 households with two participating children, and one household with three participating children.

We used linear mixed regression models with children (Level 1) clustered within households (Level 2) to estimate the mean difference in ChEAT-24 total scores and subscale scores by caregiver-reported household FI and, in separate models, by child-reported FI. Every model included a random intercept for household identifier to account for clustering of children within the same households. Caregiver-reported household FI was modeled categorically (household FI vs. no household FI) according to standard practice (ERS, 2012). Child-reported FI was modeled both categorically and continuously, consistent with previous studies (Fram et al., 2015; Landry et al., 2019b). All models were adjusted for the following: child age (in whole years, continuous), child gender (boy vs. girl), caregiver race/ethnicity (white vs. caregiver of color), caregiver highest level of education (three categories: high school diploma or less, some college without a bachelor's degree, bachelor's degree or more), and household income as percentage of the poverty line (continuous). Caregiver race/ethnicity and education were collapsed into two and three categories, respectively, to preserve statistical power. We adjusted for child age, caregiver race/ethnicity, caregiver education, and household income because each of these variables may predict both FI and ED risk, thus confounding the associations of interest. Caregiver race/ethnicity, rather than child race/ethnicity, was used because we hypothesize that caregiver race/ethnicity may be more strongly associated with experiences of structural racism (e.g., housing and employment discrimination, incarceration, and so forth), which may lead to FI (Odoms-Young & Bruce, 2018). We additionally adjusted for child gender as an independent predictor of ED risk, to optimize statistical precision.

Interaction terms between each FI variable and child gender were used to test for effect modification by gender in each of the adjusted models. When the interaction term was statistically significant, results were additionally stratified by gender. All statistical analyses were conducted using SAS version 9.4. Statistical significance was determined using an alpha level of .05.

3 | RESULTS

Sociodemographic characteristics and their relation to the ChEAT-24 total score and subscale scores can be seen in Table 2. Children had a mean age of 8.9 (SD = 0.8) years, and 46.4% were boys. A large proportion (40.7%) of the sample had a female primary caregiver of color. Specifically, for the 79 children with a caregiver of color, caregivers were Black/African American (67.1% of children), Hispanic (3.8%), Middle Eastern/North African (1.3%), Asian (2.5%), multi-racial/multi-ethnic (13.9%), and other race/ethnicity (11.4%). Due to the recruitment criteria, 46.9% of all children lived in a household with a total income below the poverty line. The majority (59.8%) of children lived in food-insecure households based on caregiver report. Similarly, more than half of children (56.7%) perceived themselves as food insecure, with a mean child-reported FI score of 2.6 (SD = 2.3) and a range of 0–10. Among all children, 122 (62.9%) reported the same food security status as their caregiver, 33 (17.0%) reported FI when their caregiver reported no FI in the home, and 39 (20.1%) reported no FI when their caregiver reported FI in the home. Children had a mean ChEAT-24 total score of 5.2 (SD = 6.2), with total ChEAT-24 scores ranging from 0 to 36. In bivariate analyses, older child age, having a caregiver of color (vs. a white caregiver), lower household income, and higher

TABLE 3 Results from linear mixed models examining the association of caregiver-reported household food insecurity (vs. no household food insecurity) with 24-item Children's Eating Attitudes Test (ChEAT-24) total and subscale scores among preadolescent children aged 8–10 years old from low-income households in southeastern Michigan

	Unadjusted estimates ^a		Adjusted estimates ^b	
	β	95% CI	β	95% CI
ChEAT-24 total score	−0.02	(−1.91, 1.87)	−0.06	(−2.01, 1.90)
Dieting subscale	−0.11	(−0.49, 0.26)	−0.11	(−0.50, 0.27)
Food preoccupation subscale	0.09	(−0.35, 0.52)	0.09	(−0.36, 0.54)
Weight preoccupation subscale	0.23	(−0.38, 0.85)	0.19	(−0.45, 0.83)
Vomiting subscale	−0.03	(−0.24, 0.17)	−0.05	(−0.26, 0.16)
Social pressure subscale	0.24	(−0.22, 0.70)	0.19	(−0.29, 0.67)

^aEstimates from separate linear mixed models where the ChEAT-24 total and subscale scores were modeled as continuous outcomes. Every model included a random intercept for household identifier to account for clustering of children within the same households. Each β value represents the mean difference in the ChEAT-24 total score or subscale score for children with caregiver-reported household food insecurity versus children with no household food insecurity.

^bAdjusted for child age, child gender, caregiver race/ethnicity, caregiver education, and household income as percentage of the poverty line.

TABLE 4 Results from linear mixed models examining the association of child-reported food insecurity (modeled both categorically and continuously) with the 24-item Children's Eating Attitudes Test (ChEAT-24) total and subscale scores among preadolescent children aged 8–10 years old from low-income households in southeastern Michigan

	Unadjusted estimates ^a		Adjusted estimates ^b	
	β	95% CI	β	95% CI
Child-reported food insecurity (vs. child report of no food insecurity)^c				
ChEAT-24 total score	2.26	(0.47, 4.05)	2.41	(0.57, 4.25)
Dieting subscale	−0.08	(−0.45, 0.30)	−0.07	(−0.45, 0.32)
Food preoccupation subscale	0.60	(0.19, 1.02)	0.55	(0.10, 0.99)
Weight preoccupation subscale	0.62	(0.02, 1.23)	0.71	(0.08, 1.34)
Vomiting subscale	0.03	(−0.17, 0.23)	−0.01	(−0.22, 0.20)
Social pressure subscale	0.34	(−0.12, 0.79)	0.35	(−0.13, 0.83)
Child-reported food insecurity score (per 1-unit higher score)^d				
ChEAT-24 total score	0.54	(0.16, 0.92)	0.61	(0.21, 1.01)
Dieting subscale	0.02	(−0.06, 0.10)	0.03	(−0.05, 0.11)
Food preoccupation subscale	0.15	(0.07, 0.24)	0.14	(0.05, 0.24)
Weight preoccupation subscale	0.08	(−0.04, 0.21)	0.11	(−0.03, 0.24)
Vomiting subscale	0.01	(−0.03, 0.05)	0.00	(−0.05, 0.04)
Social pressure subscale	0.12	(0.03, 0.22)	0.15	(0.04, 0.25)

^aEstimates from separate linear mixed models where the ChEAT-24 total and subscale scores were modeled as continuous outcomes. Every model included a random intercept for household identifier to account for clustering of children within the same households. When child-reported food insecurity is modeled categorically, each β value represents the mean difference in the ChEAT-24 total score or subscale score for children with self-reported food insecurity versus children who self-reported no food insecurity.

^bAdjusted for child age, child gender, caregiver race/ethnicity, caregiver education, and household income as percentage of the poverty line.

^cWhen child-reported food insecurity is modeled categorically, each β value represents the mean difference in the ChEAT-24 total score or subscale score for children with self-reported food insecurity vs. children who self-reported no food insecurity.

^dWhen child-reported food insecurity is modeled continuously, each β value represents the mean difference in the ChEAT-24 total score or subscale score per 1-unit increase in child-reported food insecurity score.

child-reported FI score were each associated with higher scores for one or more ChEAT-24 measures. Child gender, caregiver education, and caregiver-reported household FI were not associated with any ChEAT-24 measures in bivariate analyses.

In adjusted analyses, caregiver-reported household FI (vs. no household FI) was not associated with the ChEAT-24 total score or any subscale scores (Table 3). For the association between caregiver-reported household FI and dieting, there was evidence for effect

modification by gender (p -interaction = .04). Gender-stratified analyses identified a null association for boys ($\beta = 0.26$, 95% CI: -0.40 , 0.92). For girls, there was an inverse association, where caregiver-reported household FI (vs. no household FI) was associated with less dieting, which did not reach statistical significance ($\beta = -0.45$, 95% CI: -0.93 , 0.02). None of the other examined associations involving caregiver-reported household FI were modified by gender (effect modification analyses not shown in tables).

In contrast, children who self-reported FI had a mean ChEAT-24 total score that was 2.41 units higher (95% CI: 0.57 , 4.25) compared to children who reported no FI. Child-reported FI (vs. child report of no FI) was also associated with more food preoccupation ($\beta = 0.55$, 95% CI: 0.10 , 0.99) and more weight preoccupation ($\beta = 0.71$, 95% CI: 0.08 , 1.34). However, child-reported FI (vs. child report of no FI) was not associated with dieting, vomiting, or social pressure to eat/gain weight (Table 4). When modeled categorically, none of the examined associations involving child-reported FI were modified by gender (data not shown).

When child-reported FI score was modeled continuously, each 1-unit increase in child-reported FI score was associated with a 0.61-unit increase (95% CI: 0.21 , 1.01) in mean ChEAT-24 total score. Higher child-reported FI score was also associated with more food preoccupation ($\beta = 0.14$, 95% CI: 0.05 , 0.24) and more social pressure to eat/gain weight ($\beta = 0.15$, 95% CI: 0.04 , 0.25). Continuous child-reported FI score was not associated with dieting, weight preoccupation, or vomiting in the overall sample (Table 4). However, the association between child-reported FI score and dieting was modified by gender (p -interaction = .002). In gender-stratified analyses, higher child-reported FI score was associated with more dieting among boys ($\beta = 0.16$, 95% CI: 0.04 , 0.29) but was not associated with dieting among girls ($\beta = -0.06$, 95% CI: -0.16 , 0.04). None of the other examined associations involving the continuous measure of child-reported FI were modified by gender (data not shown).

4 | DISCUSSION

To the best of our knowledge, this is the first study to examine how both caregiver- and child-reported FI are associated with ED-related outcomes among low-income preadolescent children. We found that child-reported FI, but not caregiver-reported household FI, was associated with more ED risk factors/symptoms. Specifically, more child-reported FI was associated with higher ChEAT-24 total score, more food preoccupation, more weight preoccupation, and more social pressure to eat or gain weight.

The associations of child-reported FI with a higher mean ChEAT-24 total score and more food preoccupation were robust regardless of whether child-reported FI was modeled continuously or categorically. These findings are consistent with previous literature in adults suggesting an association of self-reported FI with higher composite measures of disordered eating (Barry et al., 2021; Becker et al., 2019; El Zein et al., 2019; Laraia et al., 2015) and with more food preoccupation (Barry et al., 2021; Poll et al., 2020). The association of child-

reported FI (vs. child report of no FI) with more weight preoccupation is consistent with the study by Altman et al. (2019) who found an association between child-reported FI (vs. no FI) and more body dissatisfaction among children in grades 4–8. In addition, we found that when modeled continuously, child-reported FI was associated with more social pressure to eat or gain weight. This finding corroborates prior studies showing that parents in food insecure households are more likely to be concerned with child weight (Bauer et al., 2015) and to use pressured feeding practices (Conlon et al., 2015). Our finding suggests that children who report FI may sense this parental pressure. There was no association between child-reported FI and vomiting in this study, which is consistent with a previous study in adolescents (Hooper et al., 2020) but in contrast to findings in adults (Barry et al., 2021; Becker et al., 2019). It may be that self-induced vomiting is too rare to study in non-adult samples.

Overall, our results reflect small but clinically meaningful differences in ED risk factors/symptoms according to child-reported FI. For example, Lommi et al. (2020) found that among Finnish children (mean age of 11.6 years), those who screened positive for disordered eating symptoms based on a validated questionnaire had a mean ChEAT-24 total score that was 4.76 units higher compared to children who screened negative for disordered eating symptoms. These results suggest that a 2.41-unit increase in ChEAT-24 total score—the average difference between children with and without self-reported FI in our study—could explain more than half of the difference between screening positive versus screening negative for disordered eating symptoms.

Our results suggest that child-reported FI may be a more salient risk factor for ED-related outcomes than caregiver-reported household FI. Similar to Bernard et al. (2018), we found that 17.0% of children reported FI when their caregiver reported no household FI, and 20.1% reported no FI when their caregiver reported household FI. There are many reasons why a child's self-report of FI may differ from their caregiver's report. First, caregivers may be unaware of the full extent to which children perceive and are affected by FI (Bernard et al., 2018; Fram et al., 2011), or caregivers might be embarrassed to report the full extent of FI in their household (Middleton et al., 2018), while their children might be more open about FI. On the other hand, some caregivers strive to shield their children from full awareness of FI (Fitchen, 1988; Fram et al., 2011; McIntyre et al., 2003), although research suggests that many children are still aware of FI in the home, even if caregivers do not talk to them about it (Fram et al., 2011; Leung et al., 2020). More research is needed to understand why child versus caregiver reporting differences exist, including the role of enrollment in food assistance programs, which appeared to exacerbate reporting differences in one previous study (Landry et al., 2019a).

Regardless of the reason for caregiver and child reporting differences, child self-report of FI may more accurately reflect the child's own experience with FI and, thus, be more relevant to child behavioral and health outcomes. In this way, our findings align with another study where child-reported FI, but not mother-reported FI, was associated with child diet quality (Bernal et al., 2016). These findings suggest that future research on FI and children's behavioral and health

outcomes should measure child-reported FI rather than relying on caregiver report of household FI.

The salience of child perception of their ability to obtain enough quality food also suggests that traditional conceptualizations of ED-related constructs such as dietary restraint may need to be reexamined. Dietary restraint, with or without caloric deprivation, is traditionally conceptualized as a psychological effort to resist certain food types or amounts of food in order to control weight, and is associated with more ED-related outcomes (Schaumberg & Anderson, 2016). It is conceivable that children with perceived FI may engage in behaviors that mirror dietary restraint, but not with the motivation of weight loss, that are under-captured in current assessment tools. Indeed, one study in adults with FI found that intentional dietary restraint for any reason (including reasons not related to weight control) was associated with more ED symptoms (Middlemass et al., 2021). Based on findings in the present study, we hypothesize that dietary restraint for any reason, including due to FI, may lead to food preoccupation, thus increasing the risk for other ED symptoms. However, it remains to be seen whether the consequences of restraint differ according to what is driving the behavior. This is an emerging area of research that requires more study.

We observed no gender differences in the ChEAT outcomes in bivariate analyses. This is consistent with other preadolescent samples (Bernier et al., 2010; Thomas et al., 2021) and suggests that gender differences in ED symptoms may be less prominent or less detectable in preadolescents compared to older samples. Although no measures of FI were associated with dieting (i.e., restricting food for weight control) in the full sample of children, there was evidence that these associations were modified by gender: caregiver-reported household FI was marginally associated with less dieting among girls only, and child-reported FI was associated with more dieting among boys only. To the best of our knowledge, no previous research has examined this association among preadolescent children only. One study of children aged 8–15 years found that household FI was associated with more weight loss attempts (Masler et al., 2021), but this study did not restrict to preadolescent children or stratify by gender, and the method of attempted weight loss was not specified. The association between FI and more dieting in boys only might be partially explained by parenting practices in the context of FI. Loth et al. (2014) found that problematic parental feeding practices like restrictive feeding and pressure to eat—which are more common among parents in food-insecure households (Bauer et al., 2015)—were associated with more dieting in boys but not girls. Future research should continue to investigate gender differences in the association between FI and dieting among preadolescents, including potential mechanisms for these gender differences.

This study has several strengths. We used detailed, well-validated measures for exposure and outcome variables, including measures of both caregiver- and child-reported FI. In addition, we focused on a sample of preadolescent children aged 8–10 years, which is a critical age period for ED prevention that has not been well studied regarding the association between FI- and ED-related outcomes. We also examined the novel and important issue of potential effect modification by gender.

This study does have some limitations. First, the cross-sectional study design precluded the establishment of temporality between

exposures and outcomes. It is conceivable that a child's experience of ED risk factors/symptoms could increase child and caregiver attention to FI in the home, increasing report of FI through reverse causation. This study also focused on low-income, English-speaking households from southeastern Michigan, United States, which may limit generalizability. The ChEAT-24 produces a total score that is difficult to interpret, as it combines risk factors/symptoms for different EDs with different presentations. We, therefore, incorporated the ChEAT-24 subscale scores as additional outcomes to better distinguish specific ED risk factors or symptoms. These subscales significantly enhanced interpretability of the findings, although we did not have a subscale for binge-eating behavior, which has been associated with FI in older populations (Hazzard et al., 2020). In addition, combining all caregivers of color into a single category may have obscured differences between racial/ethnic identities, since this category encompassed many different racial/ethnic groups: Black/African American, Hispanic, Middle Eastern/North African, Asian, multi-racial/multi-ethnic, and other race/ethnicity. Similarly, use of binary gender options (boy or girl) may have resulted in incorrect gender labels for some children.

In conclusion, we found that child-reported FI, but not caregiver-reported household FI, was associated with ED-related outcomes among preadolescent boys and girls from low-income households. If our findings are confirmed by future research, then it is possible that FI and ED prevention/intervention programs would benefit from assessing and intervening on child self-report of FI. In addition to ensuring access to enough food for all children who report FI, it might also be helpful for programs to provide counseling to address the psychological impacts of FI in children. Finally, ED prevention/intervention programs could be targeted toward boys and girls in areas with a high prevalence of FI. Future studies should continue to investigate potential early life risk factors and mechanisms for the onset of EDs, especially in understudied groups. Specifically, large, prospective studies are needed to examine whether FI precedes the onset of ED risk factors/symptoms in preadolescents. Future research should collect data on both caregiver-reported household FI and child-reported FI and should assess well-defined ED risk factors/symptoms. Finally, future studies should continue to examine the role of potential moderators and mediators (e.g., gender, weight status, depressive symptoms, parental feeding practices, qualification for and enrollment in food assistance programs) for the association between FI and ED-related outcomes.

AUTHOR CONTRIBUTIONS

Mikayla R. Barry: Conceptualization; formal analysis; investigation; writing – original draft. **Kendrin R. Sonnevile:** Conceptualization; methodology; supervision; writing – review and editing. **Andrea R. McGowan:** Writing – review and editing. **Belinda L. Needham:** Supervision; writing – review and editing. **Lindsay C. Kobayashi:** Supervision; writing – review and editing. **Cindy W. Leung:** Conceptualization; data curation; funding acquisition; methodology; supervision; writing – review and editing.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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