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Food insecurity and child behavior problems in fragile families

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ABSTRACT

Food insecurity remains a persistent problem in the United States. Several studies have shown that food insecurity is associated with child externalizing and internalizing behavior problems. However, some potential methodological limitations remain. For example, most studies use a household measure of food insecurity while there is evidence that children, especially younger ones, tend to be shielded by their parents from experiencing food insecurity. In addition, the mechanisms through which food insecurity affects children are not well understood. This study uses longitudinal data from the Fragile Families and Child Wellbeing Study to address these limitations. Fixed-effects models show that the association is even larger using a measure of child food insecurity instead of a household one. Correlated-random effects models show a large difference in child behavior problems between food secure and food insecure children due to unobserved heterogeneity. In addition, the association between child food insecurity and child externalizing behaviors remains largely unexplained while food insecurity among adults explains almost all the variation in the association with child internalizing behaviors. Food insecure children and parents are at risk of micronutrient deficiencies, which may lead to behavior problems in young children. These findings underscore the need for greater focus on reducing the risk of food insecurity, especially for children in fragile families, in order to reduce behavior problems and improve their educational attainment.

1. Introduction

Food insecurity, the inability to access enough food to maintain a healthy and active life, is a persistent problem in the United States. Since the 2008, the rate of household food insecurity has hovered around 14%, which represents about one out of seven households (Coleman-Jensen et al., 2015). A large body of literature has documented the negative consequences of food insecurity on the well-being of children across the life-course (Alaimo et al., 2001; Belsky et al., 2010; Gundersen and Ziliak, 2015; Jyoti et al., 2005; Rose-Jacobs et al., 2008; Slopen et al., 2010). Food insecure children have poorer health outcomes and lag behind their peers in academic outcomes (Jyoti et al., 2005), leading to lower educational attainment. Furthermore, because food insecurity is concentrated among vulnerable households and children (Coleman-Jensen et al., 2015), another consequence of food insecurity is the growing inequality among children (Roustit et al., 2010).

While there is ample evidence showing that food insecurity has negative impacts on child behavior problems (e.g. Huang et al., 2010; Kimbro and Denney, 2015), these studies have several methodological limitations. First, most studies on the relationship between food insecurity and child behavior problems do not account for unobserved heterogeneity except for a handful of them (Howard, 2011; Jyoti et al., 2005). Second, children, especially younger ones, tend to be shielded by their parents from experiencing food insecurity (Coleman-Jensen et al., 2013). Most studies on child food insecurity use a household-level measure of food insecurity, which likely overstates the actual prevalence of child food insecurity. Since no studies have compared estimates between child and household food insecurity, it is remains unknown as to how shielding affects the estimates of food insecurity from previous studies. Lastly, the mechanisms through which food insecurity may lead to child behavior problems are not well understood and few studies have tested them.

This study attempts to address some of these limitations in several ways. First, I use longitudinal data from the Fragile Families and Child Wellbeing Study (FFCWS) with fixed-effects models to estimate the association between food insecurity and child behavior problems. Second, I compare the estimates using a child-level measure of food insecurity to a household-level one to account for shielding. Third, I estimate correlated-random effects models to compare the within and between estimates of food insecurity. Lastly, I test three mechanisms through which child

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food insecurity may lead to behavior problems: maternal depression, parenting stress, and parental food insecurity.

2. Background

2.1. Conceptual framework

Food insecurity could directly negatively affect child development through undernutrition and micronutrient deficiencies. Children living in food insecure households have numerous micronutrient deficiencies, including deficiencies in iron and zinc (Kirkpatrick and Tarasuk, 2008; Skalicky et al., 2006). These nutritional deficiencies, especially in young children, can lead to adverse – or under – development of the brain and its functioning (Benton, 2008; Georgieff, 2007; Knickmeyer et al., 2008), which can result in poor cognitive functioning, behavioral, and emotional problems in children (Grantham-McGregor and Ani, 2001; Lozoff et al., 2000).

Food insecurity could also indirectly affect child development through family members, most notably, parents. The Family Stress Model proposes that economic hardships such as low income and negative economic events directly affect economic pressures within the family (Conger and Conger, 2002). Examples of economic pressures are the inability to pay for basic needs or having to reduce expenses on necessities. The model suggests that during high economic pressure, such as the inability to access enough food, parents are at higher risk of emotional distress (e.g. anxiety and depression). Food insecurity could also lead to parental emotional distress, not only through stress, but also through nutritional deficiencies (Dixon et al., 2001; Tarasuk and Beaton, 1999a). Some of these nutritional deficiencies, such as a lack of folate, are known to increase the risk of depression in mothers (Alpert et al., 2000; Reynolds, 2002). This could explain why several studies find a link between food insecurity and maternal depression (Hromi-Fiedler et al., 2011; Laraia et al., 2006; Noonan et al., 2016; Whitaker et al., 2006). The parental emotional distress and accumulation of stress could disrupt the relationship between the parent and the child, and decrease parenting quality (Crnic et al., 2005; Goodman et al., 2011; Wachs et al., 2009). Parents who are too preoccupied to provide food to their children may be less likely to be able to attend to their children's needs and engage them in activities that stimulate their cognitive and social development, which may lead to behavior problems (Alpert et al., 2000; Dixon et al., 2001; Reynolds, 2002).

2.2. Existing evidence

Empirical evidence has shown an association between food insecurity and poor child developmental outcomes such as behavior problems (e.g. Howard 2011; Huang et al., 2010; Kimbro and Denney, 2015; Rose-Jacobs et al., 2008; Slack and Yoo, 2005). While there is an abundant evidence of this association, a large number of these studies have methodological limitations. For example, several of these studies are cross-sectional (e.g. Alaimo et al., 2001; Rose-Jacobs et al., 2008), and studies that use longitudinal data did not substantially improve on the cross-sectional studies as they did not account for unobserved time-invariant measures that may confound this association (Hernandez and Jacknowitz, 2009; Kimbro and Denney, 2015; Slack and Yoo, 2005; Slopen et al., 2010; Whitaker et al., 2006). An example of unobserved (time-invariant) characteristic that could affect this association is food insecurity during pregnancy, which leads to low birthweight and birth defects (Borders et al., 2007; Carmichael et al., 2007), thus increasing the risk of later behavior problems in children. Only a handful of studies have attempted to deal with these potential methodological concerns using methods such as fixed-effects models or structural equation modeling (Howard, 2011; Jyoti et al., 2005; Zaslow et al., 2009).

In food insecure households, parents usually try to shield their children – especially younger ones – from experiencing food insecurity (Coleman-Jensen et al., 2013, 2015). Descriptive statistics from the 2010–2011 Current Population Survey shows that in food insecure households, children younger than 4 years old are 50% less likely to experience food insecurity than teenage children (Coleman-Jensen et al., 2013). As a result, studies on children (especially younger ones) using a household measure of food insecurity may likely overestimate the prevalence of child food insecurity and misclassify them as food insecure while they are actually food secure. Given that no studies have compared the estimates between household and child food insecurity, it is unclear how estimates from previous studies that use household food insecurity are affected.

The potential mechanisms through which food insecurity affects child behavior problems are not well understood. The conceptual framework provided suggests three potential mechanisms through which food insecurity could lead to child behavior problems: maternal depression, parenting stress, and parental food insecurity. Only two previous studies have used longitudinal data to test potential mechanisms. Zaslow et al. (2009) use structural equation modeling to find that maternal depression mediates the relationship between household food insecurity and mental proficiency. Huang et al. (2010) use data from the Panel Study of Income Dynamics (PSID) and fixed-effects models to find that parenting distress and psychological distress mediate the association between food insecurity and child behavior problems. However, their analytical sample using listwise deletion used only 14% of the sample of children (416 children out of 2907) in the dataset, which lowers the power of the study and making it susceptible to attrition bias.

In addition to the lack of understanding about potential mechanisms that may explain these relationships, these relationships are not well understood in the context of vulnerable households such as fragile families. These families are known to be at higher risk of experiencing food insecurity and poverty. This is important because these households are typically the target recipients of public assistance programs such as the Supplemental Nutrition Assistance Program (SNAP), the School Breakfast Program (SBP), and the National School Lunch Program (NSLP). Given the high prevalence of food insecurity in the U.S. and its importance for the development of children, disentangling the consequences of food insecurity for child behavior problems adds a better understanding of health disparities and social inequalities among children.

3. Data and methods

3.1. Analytical sample

The Fragile Families and Child Wellbeing Study (FFCWS) is a longitudinal study that sampled children born between 1998 and 2000 in 20 large U.S. cities with populations of at least 200,000. Both mothers and fathers were interviewed at baseline (when the child was born) and regular intervals over time (e.g. year 1, 3, 5, and 9). When weighted, the sample is representative of unmarried mothers and "fragile families" as they are at higher risk of living in poverty and separation (Reichman et al., 2001). The core surveys were conducted by telephone and provide extensive information pertaining to family background, relationships, health, and parenting behaviors among others. The in-home survey is most of the time conducted at the home of the respondents and collects information on children's cognitive and emotional development,

health, and home environment. The in-home surveys include information relating to food insecurity and child behaviors.

The sample includes children (n = 2488) who are between ages 3 and 5 whose parent – most often mothers – have completed all 3rd and 5th year surveys (core and in-home). After excluding households with missing values on the dependent variables, the sample size for this analysis includes 2044 households with children.

3.2. Child behavior problems

Child behavior problems were measured using the Child Behavior Checklist/$1^1/_2$-5 (CBCL) (Achenbach, 1991). For each item, mothers reported whether the behavior of the child was true (0 = not true, 1 = sometimes true, or 2 = often or very true). Child behavior problems include externalizing behaviors (e.g. fights, hits others, disobedient) and internalizing behaviors (e.g. withdrawn, shy, secretive, refuses to talk). The externalizing behavior variable included 15 items at year three and 25 items at year five. The internalizing behaviors variable included 19 items at year three and 17 items at year five. The Cronbach's alphas were about 0.85 for externalizing behaviors and about 0.73 for internalizing behaviors. Both measures of child behavior problems were standardized with a mean of zero and standard deviation of one.

3.3. Key independent variables

Food insecurity was measured using 18 questions from the US Department of Agriculture Food Security Module. This module is considered the standard instrument to measure food security and includes questions related to food access and experiences in the last 12 months. For example, the first question asks whether the household worried that they would run out of food before they got enough money to buy more. The analysis considered several measures of food insecurity. To compare the estimate with previous studies, a binary measure of household food insecurity using all 18 items denotes household food insecurity with children. In addition, a continuous variable using all 18 items is also used. However, because young children are often shielded from experiencing food insecurity by their parents or the adults in the household (Coleman-Jensen et al., 2013), a household measure might misclassify some of these food secure children as food insecure. As a result, a continuous variable sums the affirmative responses to the eight questions pertaining to children (food security among children). In addition, a continuous measure uses the remaining 10 items to denote food security among adults, which was examined as a potential mechanism. The analysis presents several sets of estimates. First, estimates using the binary measure of household food insecurity with children are used to compare with previous studies. Second, estimates using a continuous measure of household food insecurity (0–18) are compared to estimates using a continuous measure of food insecurity among children (0–8). Third, estimates using the continuous measure of food insecurity among children (0–8) and the continuous measure of food insecurity among adults (0–10) are used, with the later used as potential mechanism.

Maternal depression is constructed from the Composite International Diagnostic Interview Short Form (CIDI-SF) developed by Kessler et al. (1998). Mothers are depressed if they reported feeling depressed or being unable to enjoy normally pleasurable activities in the last two weeks and had three or more additional symptoms out of seven (e.g. having trouble sleeping, feeling worthless, etc.).

Parenting stress is constructed from the following four statements: (1) being a parent is harder than I thought it would be, (2) I feel trapped by my responsibilities as a parent, (3) taking care of my child(ren) is more work than pleasure, (4) I often feel tired from raising a family. Possible responses range from 1 to 4 (strongly disagree to strongly agree).

3.4. Control variables

The analysis includes time-variant variables such as the number of children in the household and household income to poverty ratio. Other maternal characteristics include binary measures of relationship with the father (married, cohabitating, non-resident, or separated), employment status (employed or not), participation in the SNAP program, whether the mother has a new romantic partner, whether the mother was a victim of domestic violence, prior parental drug or alcohol abuse. The analysis also controls for material hardship, and social support. The material hardship measure sums the number of specific financial hardships (up to five) mothers experienced such as whether they were behind on the rent or mortgage payment, or whether the electricity or gas was turned off because of missed payments. For social support, mothers report whether they can count on someone to: loan her $200, loan her $1000, provide a place to live, and to help with emergency child care. Child health status is measured using a binary variable indicating whether the child was in poor, fair health, or good health. In addition, a binary measure of whether the child had an asthma attack in the past 12 months was included.

Additional parenting measures that may affect child behavior problems are included: parents' relationship quality, shares parenting responsibilities with the father, and parenting warmth. Mother indicate on a scale of 1 to 5 (poor to excellent) their relationship with the father. To measure sharing parenting responsibilities, six items on a scale of 1 (never) to 4 (always) from the mother's responses about the father's involvement with the child are averaged. To measure parenting warmth, five items that ask the caregiver how many days a week (zero to seven) she spends doing activities – such as reading stories – with the child are averaged.

The analysis also included other control variables that are time-invariant characteristics to estimate correlated-random effects models. Examples of these variables are mother's race (white, black, hispanic, and other race), education (less than high school, high school, some college, or college graduate), maternal pre-natal smoking, and low birthweight.

3.5. Analysis

First, fixed-effects regression models estimate the association between food insecurity and child behavior problems in this sample of children in vulnerable households. The models compare estimates between continuous measures of food insecurity among children and household food insecurity with children. Second, the associations of food insecurity are decomposed into within and between estimates using correlated-random effects (Mundlak, 1978), and hybrid models (Allison, 2009). The correlated-random effects models are estimated by including time-invariant variables and cluster-specific – in this case, mother – means of each variable (Schunck, 2013). The hybrid model is similar to the correlated-random effects model and is another "between-within" method (Sjölander et al., 2013). These models may help understand how much the estimates from some of the previous studies may be driven by unobserved heterogeneity between food insecure and food secure children. Lastly, additional fixed-effects models are estimated and include potential mechanisms through which food insecurity among children might affect behavior problems.

3.6. Sensitivity analysis

The Fragile Families data has missing values on several variables. Studies using this dataset utilize several strategies to deal with missing values. The first one is to discard the observations with missing values (also known as listwise deletion). One downside of this method is the possibility that the households with children dropped from the sample are different from the ones who remain in the sample. Another disadvantage is that the statistical power decreases with a smaller sample. A second method is to create binary variables for the missing values rather than dropping them. A third method that also preserves observations with missing values is to impute them. Recent studies have used imputation by multiple chained equations (Royston 2004, 2005). Since the results were not sensitive to the imputation method, only the results from multiple imputation are reported.

Previous studies restrict the analysis to low-income households to ensure that confounding factors related to income do not change the results (e.g. Huang et al., 2010; Kimbro and Denney, 2015). The results were similar when restricting the sample to households with income less than 185% of the federal poverty guidelines.

4. Results

Table 1 provides descriptive characteristics of the sample by food security status. The first two columns compare between food secure and food insecure households with children using a binary measure. Households with children who answered affirmatively to three or more of the 18 items are considered food insecure. The remaining columns compare between food secure and food insecure children using a binary measure. Children in households who answered affirmatively to two or more of the eight items about children are considered food insecure. While about 19%

Table 1
Descriptive statistics of the Fragile Families sample by food security status.

Variable	Food secure household	Food insecure household	Food secure child	Food insecure child
Child behavior problems at year 5				
Externalizing behaviors (0–38)	9.0	11.9	9.3	12.3
Internalizing behaviors (0–24)	4.0	5.9	4.2	5.9
Maternal depression (%)	14.2	29.9	15.5	36.6
Parental characteristics				
Parenting stress (1–4)	2.1	2.4	2.2	2.5
Parenting warmth (0–7)	5.0	4.9	5.0	4.8
Parents' relationship quality (1–5)	3.2	2.5	3.1	2.5
Share parenting responsibilities (1–4)	2.1	1.5	2.0	1.3
Child health status				
Poor, fair, or good health	10.6	14.4	10.5	21.0
Had an asthma attack in last 12 months	7.6	11.0	7.9	12.3
Maternal age at baseline	25.4	24.4	25.2	24.8
Mother race (%)				
White	23.9	16.2	22.8	19.0
Black	51.1	59.3	52.3	57.1
Hispanic	21.7	21.2	21.7	20.2
Other	3.3	3.3	3.2	3.7
Mother education at baseline (%)				
Less than high school	29.6	38.2	30.7	37.4
High school	30.6	36.8	30.8	40.5
Some college	26.6	23.0	26.5	19.4
College graduate and beyond	13.2	3.0	11.9	2.7
Mother employed (%)	60.4	54.2	59.7	53.0
Income to poverty ratio	2.1	1.1	1.9	1.1
Mother relationship with father (%)				
Married	32.4	13.6	30.6	7.9
Cohabitate	12.8	12.7	12.4	16.6
Non-resident	3.2	5.7	3.5	5.9
Separated	51.6	68.0	53.5	69.6
Number of children	2.5	2.8	2.5	2.9
Mother is an immigrant	11.2	7.8	10.6	9.3
Mother has a new romantic partner (%)	26.9	29.3	28.1	33.8
Mother social support (0–4)	3.2	2.5	3.2	2.3
Material hardship (0–5)	0.9	1.9	1.0	2.0
Receives food stamps (%)	40.6	65.1	43.4	66.6
Domestic violence (%)	10.0	12.9	10.3	13.1
Past drug or alcohol problems (%)	20.9	35.5	22.4	39.2
Mother smoked during pregnancy	18.5	27.2	19.6	27.5
Low birthweight	9.4	12.4	9.7	13.2
Number of observations	1651	393	1880	152

The sample size includes 2044 mothers and children. The food insecure household variable is binary and uses all 18 items of the Food Security Module. Households with children answering affirmatively to three or more of the items are considered food insecure. The food insecure child variable is binary and uses the eight items about children. Children in households that answered affirmatively to two or more of the items are considered food insecure.

(n = 393) of households with children are considered food insecure, only about seven percent of children (n = 152) do in fact experience food insecurity. This means that in more than half (61%) of food insecure households with children in this sample, mothers (and potentially other adults) shield their young children from experiencing food insecurity. Given that previous studies have mostly relied on the household measure, it is unknown how this shielding affects the estimates of food insecurity.

Food insecure children are worse off than food secure children as they are in poorer health (21%), and are more likely to have low birthweight (13.2%). In addition, their mothers are more likely to be depressed (36.6%), have lower levels of education, are more likely to be separate from the father (69.6%), and to have smoked during pregnancy (27.5%)

Table 2 presents results from fixed-effects models including time-variant covariates showing the association between food insecurity and child behavior problems. The table compares between two measures of food insecurity: the continuous measure of household food security with children (using all 18 items) and the continuous measure of food security among children (using the eight children items). The standard errors are clustered at the city-level. Each affirmative response on an item on the child food insecurity module increases child externalizing behaviors by 0.07 standard deviations and child internalizing behaviors by 0.06 standard deviations. While the associations between food insecurity and child behavior problems are statistically significant using both child and household measures, the coefficients are larger when using food insecurity among children.

Table 3 compares the estimates between random-effects (Model 1), fixed-effects (Model 2), correlated-random effects (Model 3), and hybrid model (Model 4). The correlated-random effects models include time-invariant variables and cluster-specific means of each variable (Schunck, 2013). The hybrid model is similar to the correlated-random effects and is a "between-within" estimation method (Sjölander et al., 2013). These models help understand how unobserved heterogeneity may affect the estimates of the associations between food insecurity and child behavior problems. All the models use a continuous measure of the count of affirmative responses to the eight items about children.

For child externalizing behaviors, the estimate of food insecurity among children using random-effects (0.092) is larger than fixed-effects (0.065). The estimate of the cluster-specific mean of food insecurity among children in the correlated-random effects model is the within estimate of food insecurity among children, which is the same estimate as in the fixed-effects model. The estimate of the deviation scores of food insecurity among children is the between estimate. In the hybrid model, the estimate of the deviation scores of food insecurity among children is the within estimate, and the mean food insecurity among children is the sum of the within and between estimates (0.065 + 0.05 = 0.0116). The Wald test of equivalence of

Table 2
Fixed-effects estimates predicting child behavior problems (n = 2044).

	Externalizing behaviors		Internalizing behaviors	
Food insecurity	0.07**		0.06*	
among children (0–8)	(0.02)		(0.03)	
Food insecure		0.02*		0.03**
household (0–18)		(0.01)		(0.01)
Material hardship	0.02	0.02	0.03	0.02
	(0.02)	(0.02)	(0.02)	(0.02)
Mother is employed	−0.01	−0.01	−0.00	−0.01
	(0.03)	(0.03)	(0.05)	(0.05)
Income to poverty ratio	0.02	0.02	−0.00	−0.00
	(0.01)	(0.01)	(0.01)	(0.01)
Mother is married	0.05	0.05	−0.07	−0.06
	(0.12)	(0.12)	(0.10)	(0.10)
Mother is cohabitating	0.00	0.00	0.04	0.04
	(0.09)	(0.09)	(0.05)	(0.05)
Father is nonresident	0.08	0.08	0.18	0.18
	(0.10)	(0.10)	(0.11)	(0.11)
Mother has a new partner	0.05	0.05	−0.03	−0.03
	(0.05)	(0.05)	(0.06)	(0.06)
Number of children	0.05*	0.05*	0.05**	0.05**
	(0.02)	(0.02)	(0.02)	(0.02)
Social support	−0.02	−0.02	0.02	0.02
	(0.03)	(0.03)	(0.03)	(0.03)
Domestic violence	−0.02	−0.02	−0.08	−0.09
	(0.06)	(0.03)	(0.07)	(0.07)
Drug or alcohol abuse	0.06	0.06	−0.05	−0.05
	(0.04)	(0.04)	(0.05)	(0.05)
Receives SNAP benefits	0.11*	0.11*	0.04	0.04
	(0.04)	(0.04)	(0.06)	(0.06)
Child is in poor health	0.05	0.05	0.16**	0.16*
	(0.06)	(0.08)	(0.06)	(0.06)
Child had an asthma attack	0.05	0.05	−0.04	−0.04
	(0.08)	(0.08)	(0.09)	(0.08)
Shares parenting responsibilities	0.02	0.02	−0.01	−0.01
	(0.01)	(0.01)	(0.01)	(0.01)
Parental warmth	−0.01	−0.01	0.01	0.01
	(0.02)	(0.02)	(0.03)	(0.03)
Parents relationship quality	−0.04*	−0.04*	−0.02	−0.02
	(0.02)	(0.02)	(0.03)	(0.03)

Clustered standard errors at the city-level in parentheses. ** $p < 0.01$, * $p < 0.05$.
The food insecurity among children variable is continuous and counts the number of affirmative responses to the eight items about children. The food insecure household with children variable is continuous and counts the number of affirmative responses to all 18 items.

Table 3
Random-effects, fixed-effects, correlated random-effects, and hybrid linear regression models predicting child behavior problems (n = 2044).

	Model 1 Random effects	Model 2 Fixed effects	Model 3 Correlated random effects	Model 4 Hybrid
Externalizing behaviors				
Food insecurity among children (cont 0–8)	0.092**	0.065**	0.065**	
	(0.019)	(0.023)	(0.025)	
Food insecure (clustered-specific mean)				0.065**
				(0.025)
Food insecure (deviation score)			0.05	0.116**
			(0.039)	(0.029)
Internalizing behaviors				
Food insecurity among children (cont 0–8)	0.113**	0.061*	0.061*	
	(0.019)	(0.027)	(0.026)	
Food insecure (clustered-specific mean)				0.061*
				(0.026)
Food insecure (deviation score)			0.099**	0.160**
			(0.026)	(0.028)

The food insecurity among children measure is continuous and includes the eight items about the child. Fixed-effects models include all time-variant factors from Table 2. All other models include both time-variant and time-invariant factors from Table 1. Fixed-effects estimates include clustered standard errors at the city-level.
** $p < 0.01$, * $p < 0.05$.
Fail to reject random-effects model for externalizing behaviors, $\chi^2 = 1.71$ ($p = 0.19$).
Reject random-effects model for internalizing behaviors, $\chi^2 = 6.70$ ($p < 0.01$).

Table 4
Random-effects, fixed-effects, hybrid, and correlated random-effects linear regression models predicting child behavior problems (n = 2044).

	Model 1 Random effects	Model 2 Fixed effects	Model 3 Correlated random effects	Model 4 Hybrid
Externalizing behaviors				
Food insecure household with children (binary)	0.222**	0.101*	0.101*	
	(0.039)	(0.051)	(0.050)	
Food insecure (clustered-specific mean)				0.101*
				(0.050)
Food insecure (deviation score)			0.273**	0.374**
			(0.081)	(0.063)
Internalizing behaviors				
Food insecure household with children (binary)	0.337**	0.271**	0.270**	
	(0.039)	(0.052)	(0.052)	
Food insecure (clustered-specific mean)				0.270**
				(0.026)
Food insecure (deviation score)			0.127	0.396**
			(0.079)	(0.060)

The household food insecurity with children measure is binary and uses all 18 items. Fixed-effects models include all time-variant factors from Table 2. All other models include both time-variant and time-invariant factors from Table 1. Fixed-effects estimates include clustered standard errors at the city-level. ** $p < 0.01$, * $p < 0.05$.
Reject random-effects model for externalizing behaviors, chi squared = 11.51 ($p < 0.01$).
Fail to reject random-effects model for internalizing behaviors, chi squared = 2.54 ($p = 0.11$).

within and between estimates fails to reject the null hypothesis ($p = 0.19$), thus failing to reject the random-effects model.

For internalizing behaviors, the between estimate is larger than the within estimate and is statistically significant. The Wald test of equivalence between the two estimates rejects the null hypothesis ($p < 0.01$), and the random-effects model is rejected.

Table 4 presents the same models as Table 3 using a binary measure of household food insecurity with children (using all 18 items). For externalizing behaviors, the between estimate is almost three times larger (0.273) than the within estimate (0.101) in the correlated-random effects model. This may explain the large association of household food insecurity with children on externalizing behaviors in previous studies. On the other hand, the between estimate is about half (and statistically insignificant) than the within estimate for child internalizing behaviors. The Wald test fails to reject the random-effects model.

Table 5 presents fixed-effects models testing three potential mechanisms through which food insecurity among children may lead to behavior problems: maternal depression, parenting stress, and food insecurity among adults. Both food insecurity among children (0–8) and food insecurity among adults (0–10) are continuous. Model 1 shows the same estimate from the fixed-effects models in Table 2 and Table 3 (Model 2) accounting for time-variant characteristics. Model 2 controls for maternal depression, which does not change the association between child food insecurity and behavior problems. Model 3 includes parenting stress, which slightly reduces the size of the coefficient of child food insecurity (about 10%). Model 4 adds parental food insecurity. While the size of the association increases for externalizing behaviors, it becomes statistically insignificant for internalizing behaviors. Model 5 includes all the mechanisms and shows similar estimates from Model 4. While the items about adults and children could be separated into two measures, the children's measure is to some degree dependent on the adult one. This is because the Food Security Module has three stages of screeners. The first stage is administered to all households, and to reduce respondent burden,

Table 5
Mechanisms predicting behavior problems at year 5 (n = 2044).

	Model 1	Model 2	Model 3	Model 4	Model 5
Externalizing behaviors					
Food insecurity among children (cont 0–8)	0.065**	0.064**	0.057*	0.077*	0.073*
	(0.023)	(0.024)	(0.023)	(0.037)	(0.035)
Maternal depression		0.048			0.030
		(0.054)			(0.056)
Parenting stress			0.152**		0.152**
			(0.037)		(0.039)
Food insecurity among adults (cont 0–10)				−0.099	−0.015
				(0.021)	(0.021)
Internalizing behaviors					
Food insecurity among children (cont 0–8)	0.061*	0.060*	0.056*	0.002	0.000
	(0.027)	(0.027)	(0.028)	(0.041)	(0.041)
Maternal depression		0.012			0.006
		(0.050)			(0.049)
Parenting stress			0.083*		0.076
			(0.042)		(0.042)
Food insecurity among adults (cont 0–10)				0.050*	0.047*
				(0.020)	(0.020)

All fixed-effects models include the time-variant variables from Table 2. Regression estimates include clustered standard errors at the city-level. ** $p < 0.01$, * $p < 0.05$. The food insecurity among children measure is continuous and sums the responses to the eight items about children. The food security among adults measure is continuous and sums the responses to the 10 items about the adults.

those who did not answer affirmatively are screened out. For households with children, three items about the household (and adults) and two items about children are administered in the first stage. As a result, the affirmations to the questions about children can depend on the household (and adult) ones.

5. Discussion

This study uses longitudinal data from the Fragile Families and Child Wellbeing Study to examine the relationship between food insecurity and child externalizing and internalizing behavior problems. Fixed-effects models show that food insecurity is associated with child externalizing and internalizing behavior problems. Comparing estimates between household food insecurity with children and food insecurity among children to account for shielding, this association is larger when using the food insecurity among children measure. Using correlated-random effects, I find a statistically insignificant between estimate for externalizing behaviors and a larger significant one for internalizing behaviors. This indicates that there is some unobserved heterogeneity that explains differences in internalizing behaviors between food secure and food insecure children. In addition, three mechanisms through which food insecurity among children may affect behavior problems are examined. For child externalizing behaviors, the association remains unexplained and statistically significant. On the other hand, while maternal depression and parenting stress do not substantially affect the association with internalizing behaviors, food insecurity among adults makes it statistically insignificant.

The findings are generally in line with previous research on food insecurity and child behavior problems. However, it is difficult to determine whether the estimates from previous studies underestimate or overestimate these associations for a few reasons. Several of these studies use a household-level measure of food insecurity, which includes food secure children who are shielded by their parents from experiencing food insecurity (Coleman-Jensen et al., 2013). While the issue of shielding may result in an underestimate of the association of food insecurity, the correlated-random effects models show a potentially large between estimate of household food insecurity on externalizing behaviors, which could lead to an overestimate. The estimates from this study might be not directly comparable to previous studies due to the nature of the sample. This sample is representative of young children (between 3 and 5 years old) in fragile families. Other studies have used other sources of longitudinal data such as the Early Childhood Longitudinal Study (Birth and Kindergarten cohorts), the Panel Study of Income Dynamics (PSID), the Illinois Families Study (IFS), and the Project on Human Development in Chicago Neighborhoods (PHDCN) among others. For example, children in the PSID and PHDCN studies are on average older than the ones in this study.

The analysis of potential mechanisms differs from previous studies showing that maternal depression and parenting stress explain the association between food insecurity and child behavior problems (Huang et al., 2010; Zaslow et al., 2009). I find that these factors do not explain the association between food insecurity among children and child externalizing behaviors, which remains unexplained. For internalizing behaviors, food insecurity among adults instead explains most of this association.

These two different findings have different implications for the multifaceted relationships between child food insecurity and behavior problems. For externalizing behaviors, one potential unexplored mechanism is micronutrient deficiencies (through undernutrition and malnutrition). Several studies in the U.S. and Canada have found that food insecure households have multiple micronutrient deficiencies (Cristofar and Basiotis, 1992; Rose and Oliveira, 1997; Roustit et al., 2010; Skalicky et al., 2006; Tarasuk and Beaton, 1999a,b; Tarasuk, 2001). Some of these deficiencies can lead to underdevelopment of the brain of children (Benton, 2008; Georgieff, 2007), which likely results in behavior problems (NICHD, 1998). This study does not have measures of these potential deficiencies. To my knowledge, there are no longitudinal studies that have these measures. The main source of data for micronutrient deficiencies is the National Health and Nutrition Examination Survey (NHANES), which is a repeated-cross sectional dataset. However, the survey does not have the rich set of measures that the Fragile Families study has, which is a greater trade-off.

On the other hand, the food security of the parent (or adults) strongly affects the risk of internalizing behavior problems in children. This may indicate that even if the child is food secure, having a food insecure parent (or adult) in the household has

negative impacts on internalizing behaviors. This may explain why parental food security has a stronger relationship with the emotional well-being (internalizing behaviors) of young children. Both food insecurity among children and food insecurity among adults have negative consequences on children. It is imperative to prevent families from becoming food insecure in the first place. Public assistance programs have been fairly effective in reducing food insecurity and poverty. For example, there is evidence that the Supplementation Nutrition Assistance Program is effective in reducing food insecurity and poverty (Kreider et al., 2012; Ziliak, 2015). Other public assistance programs for children and families such as the National School Lunch Program (NLSP), the Special Supplemental Nutrition Program for Women Infants, and Children (WIC), and the School Breakfast Program (SBP) have been found to improve food security (Bartfeld and Ahn, 2011; Gundersen et al., 2012; Kreider et al., 2016). Given the effectiveness of the SNAP program in reducing food insecurity, it is important to ensure that eligible families participate in the program. The participation rate in the program was estimated at about 72% in 2009 (Leftin et al., 2011), which means that over a quarter of eligible households did not participate in the program. In addition, it has been argued that the level of benefits should be increased (Beatty and Tuttle, 2015). The 2010 Healthy, Hunger-Free Kids Act includes a Community Eligibility Provision (CEP), which enables schools and school districts in low-income areas to provide free meals (through SBP and NSLP) at no cost to all students. However, take-up rates, while on the rise, have been lower than desirable at about 45% because participation is voluntary (Segal et al., 2016). Other interventions targeting financial planning and mealtime planning could also reduce food insecurity (Fiese et al., 2016).

This study has several potential limitations. First, as aforementioned, the analysis cannot test for micronutrient deficiencies as a potential mechanism through which food insecurity could contribute to child behavior problems. Second, despite the use of longitudinal data and fixed-effects models, it is difficult to infer causality from them. While estimates from fixed-effects models account for observed time-variant and unobserved time-invariant factors, these estimates may be biased if there are omitted time-variant factors that affect both food insecurity among children and behavior problems. It is also possible that the mechanisms tested are merely proxy variables for economic circumstances. Low-income mothers are more likely to experience depression, parenting stress, and food insecurity. Another limitation relates to the generalizability of the findings. The Fragile Families data is representative of non-marital births in large urban cities, thus the results are generalizable to young children in these fragile families. This could explain why other studies find that parental characteristics other than food insecurity among adults explain the association between food insecurity and child behavior problems (Huang et al., 2010; Slack and Yoo, 2005; Zaslow et al., 2009). Nevertheless, these fragile families are the target populations that public assistance programs are designed to affect.

Despite these limitations, the study shows that food insecurity among children has negative associations with child behavior problems, and that food insecurity among adults explains most of the association between food insecurity among children and internalizing behavior problems. There is evidence that food insecurity and undernutrition have negative intergenerational consequences on health (Li and An, 2015). Reducing the prevalence of food insecurity could reduce these negative intergenerational consequences and also reduce health disparities. Programs that are designed to target food insecurity among vulnerable families would be effective in reducing child behavior problems, which would improve their educational attainment (McLeod and Kaiser, 2004).

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