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Evidence from the Panel Study of Income Dynamics (PSID)

Jin Huang

Center for Social Development

Karen M. Matta Oshima

Brown School, Washington University in St. Louis

Youngmi Kim

Center for Social Development

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Washington University in St. Louis

Does Household Food Insecurity Affect Parental Characteristics and Child Behavior?: Evidence from the Panel Study of Income Dynamics (PSID)

This study examines the link between household food insecurity and child behavior problems mediated through parental characteristics (parenting stress, parental warmth, psychological distress, and parent's self-esteem) using two waves of data from the Child Development Supplement in the Panel Study of Income Dynamics. Analyses of fixed-effects models are conducted on a low-income sample of 416 children from 249 households. This study finds that the effects of food insecurity on child behavior problems are mediated by parenting stress. However, two robustness tests show different results from those of the fixed-effects models. This inconsistency suggests that the complicated relationship between household food insecurity and child behavior problems needs to be investigated further with different methodology and measures in the future.

Key words: *child well-being, behavior problems, food insecurity, material hardship, parental characteristics*

Introduction

According to the U.S. Department of Agriculture, households are food insecure if they have “limited or uncertain availability of nutritionally adequate and safe foods or limited or uncertain ability to acquire acceptable foods in socially acceptable ways” (Bickel, Nord, Price, Hamilton, & Cook, 2000, p. 6). The prevalence of food insecurity for households with children in the United States has persisted at nearly 16% for the past decade (Nord, 2003; Nord, Andrews, & Carlson, 2005, 2008). This number is even higher for socioeconomically disadvantaged groups: about 30% for female-headed households and 20% for African-American households.

Household food insecurity has negative impact on multiple aspects of child well-being (Ashabi & O’Neal, 2008; Gundersen, 2009). Previous studies have found food insecurity correlated with child behavior problems (Alaimo, Olson, & Frongillo, 2001; Dunifon & Kowaleski-Jones, 2003; Martorell, 1996; Pollitt, 1994; Wachs, 1995). Slack and Yoo (2005) further suggest that the relationship between food insecurity and child behavior problems is mainly mediated by the quality of parenting and the parent’s mental health status. This mediation mechanism, consistent with the perspective of the Family Stress Model (Conger & Donnellan, 2007), has important implications for interventions for child behavior problems, and indicates that the potential effects of food insecurity should be taken into account.

A mediation relationship suggests that food insecurity is a determinant of both parental characteristics and child behavior problems. However, previous empirical studies have mainly focused on the correlation of food insecurity with parental characteristics and behavior problems. Therefore, this study further evaluates this mediation mechanism among food insecurity, parental

characteristics, and child behavior problems using the Child Development Supplement (CDS) from the Panel Study of Income Dynamics (PSID).

Background

Food Insecurity and Consequences for Child Well-being

Despite increases in federal expenditures for food assistance and several programs specifically targeting households with children (including WIC, School Breakfast and School Lunch, and Child and Adult Care Food program), the food insecurity status of children has not improved consistently in the last decade (Dunifon and Kowaleski-Jones, 2003). The percentage of households with children in food insecurity declined from 17.4% in 1995 to 14.8% in 1999, then rebounded to 17.6% in 2004 (Nord, 2003; Nord, et al., 2005). The prevalence of food insecurity is about twice as high for households with children compared to those without children. In 2007, about six million households with children had food insecurity problems (Nord, et al., 2008). More seriously, in 2005, among 2.2 million low-income families with severe food insecurity, 38% were households with children, a higher rate than any type of adult-only households (Nord, 2007). Food insecurity for households with children seems to be a persistent hardship for many families; about 50% of households with food insecurity in 1997 remained food insecure in 1999 (Hofferth, 2004).

There is considerable evidence that food insecurity is associated with multiple dimensions of child development. Children living with food insecurity may have nutritional deficiencies (Ashiabi & O'Neal, 2007; Cook et al., 2004; Olson, 1999) and lower nutrition intake than those without food insecurity (Rose, 1999). Children's physical health can also be influenced by food insecurity; Alaimo and colleagues (2001) argue that food-insecure children experience more frequent stomachaches, headaches, and colds than children in households without food insecurity. The same study reports that food insecurity may affect cognitive and psychological development of children, indicated by educational performance, use of mental health services, and social interactions. Children living in food-insecure households are more likely to experience stressful life events (Weinreb, et al., 2002). As measured on the Pediatric Symptom Checklist, a standardized scale of psychosocial dysfunction, low-income children with food insecurity experiences report more behavioral, emotional, and academic problems when compared with low-income children without food insecurity (Kleinman, et al., 1998).

Food Insecurity and Child's Well-being: What Mechanism?

To develop effective interventions and provide better support for food-insecure households with children, it is important to understand how food insecurity influences child well-being. Several mechanisms have been proposed to explain the link between food insecurity and child well-being. First, food insecurity may link to a child's physical and mental health directly. As suggested by Campbell (1991), food insecurity can be a direct predictor of poor nutritional state; poor physical, social, and mental well-being; and overall lower quality of life.

Studies by Ashiabi and O'Neal (2007 & 2008) support the mechanism hypothesized by Campbell (1991) with empirical evidence. However, in contrast to Campbell's model, Ashiabi and O'Neal include measures of quality of parenting and parent's mental health status to examine the possibility that parental characteristics are mediators between food insecurity and child well-being. Kleinman

and his colleagues (1998) argue that parents' emotional distress is an important factor related to the connection between food insecurity and child behavior problems. Weinreb's study (2002) also finds that the mother's distress is highly significant in models examining the effects of food insecurity on children's anxiety and tendency to internalize problems.

The hypothesized effects of food insecurity mediated by parental characteristics are consistent with the Family Stress Model (FSM) (Conger & Donnellan, 2007; Haveman & Wolfe, 1995). The FSM is based on the theoretical perspective that economic hardship correlates with family functioning and negative well-being and behaviors of both parents and children. The FSM proposes that family economic hardship (such as food insecurity) increases the risk of emotional distress and marital conflict between parents; further reduces parents' nurturing and involvement in child development; and consequently, has negative effects on child well-being. The FSM posits a mediating mechanism through the impact of parental characteristics between hardship and child well-being.

Several studies have examined the effects of food insecurity on children through parental characteristics (for example, Ashiabi & O'Neal, 2007; Slack & Yoo, 2005). Using externalizing and internalizing behavior problems measured for two different age groups (3-5 and 6-12 years) as dependent variables, Slack and Yoo (2005) investigate whether the influence of food insecurity on child behavior problems was mediated by parental characteristics in the Illinois Families Study (IFS). Parental characteristics are measured by parenting stress, parental warmth, and psychological distress. Before parental characteristics are controlled for (Model 1 in Slack and Yoo (2005)), food insecurity is positively related to both types of behavior problems for the younger group, but only internalizing behavior problems for the older group. However, when parental characteristics are included in the analysis (Model 2 in Slack and Yoo (2005)), the significance of food insecurity disappears. Among the indicators of parental characteristics, parenting stress is the strongest predictor of child's behavior problems in this study, positively related to two different types of behavior problems in the two age groups. Therefore, Slack and Yoo (2005) support a significant indirect association between food insecurity and child behavior problems.

Although not focused on child behavior problems, Ashiabi and O'Neal (2007) also provide evidence of the mediation mechanism by using Structural Equation Modeling (SEM). Ashiabi and O'Neal (2007) test several potential mediators between food insecurity and adolescent global health status, including the quality of parenting and parental mental health problems. The SEM model with all mediators included has the best model fit. Household food insecurity has significant negative effects on these mediators and all of the hypothesized mediators have the expected effects on adolescent physical health status.

These empirical studies are likely to be limited by using less reliable measures of food insecurity than the standardized 18-item scale designed by the USDA. Ashiabi and O'Neal (2007) use a two-item measure for household-level food insecurity, while Slack and Yoo (2005) measure child-level food insecurity with a four-item scale. With the child-level measure, it seems more reasonable to assume a direct relationship between food insecurity and a child's behavior problems rather than an indirect one mediated through parental characteristics. More importantly, the results discussed above only indicate the correlation of food insecurity with parental characteristics and child behavior problems. Neither the method of difference in coefficients (Slack & Yoo, 2005) nor SEM (Ashiabi & O'Neal, 2007) is adequate to show that food insecurity is a determinant of parental characteristics and child's behavior problems.

Another limitation of these studies is that they do not fully explore other possible explanations for their findings. The mediation mechanism is one possible explanation supported by the results of the stepwise regression in Slack and Yoo (2005). Alternative interpretations that could explain the confoundedness of food insecurity and parental characteristics include the possibility that parental characteristics (i.e., parental distress) may cause both food insecurity and child behavior problems or that there are some underlying factors not discovered behind the associations of food insecurity, parental characteristics, and child behavior problems.

Finally, these studies are limited by not taking full advantage of the statistical methods they used. To test a mediation relationship, the hypothesized mediators should be regressed on the main independent variables (food insecurity in this case) in regression analyses (Baron & Kenny, 1986; Holmbeck, 1997; MacKinnon, Fairchild, & Fritz, 2007); however, Slack and Yoo (2005) fail to do this. Also, in addition to fitting regression models simultaneously to evaluate mediation, one major benefit of using an SEM analysis is to test the equivalence of different conceptual models to evaluate the relative quality of possible alternative explanations. However, Ashiabi and O'Neal (2007) do not take advantage of this benefit by testing the counterfactual theoretical interpretations that compete with the proposed mediation mechanism.

This study addresses some of the limitations in previous studies (see the discussion in the Methods section) while exploring the relationships among food insecurity, parental characteristics, and child behavior problems. Using data and methods different from previous studies would provide better insights as to how household food insecurity affects child's well-being.

Methods

Data and Sample

This study uses two waves (1997 and 2002) of the Child Development Supplement (CDS) from the Panel Study of Income Dynamics (PSID). The PSID is a longitudinal study that collects demographic information and socioeconomic characteristics from a nationally representative sample of individuals and their families, annually from 1968-1997 and biennially thereafter. In 1997 and 2002, the PSID supplemented its core data collection with additional information on a group of parents and their children in the CDS. The CDS studies a broad array of developmental outcomes of children 0-12 years old in 1997, including physical health, emotional well-being, behavior, cognitive and academic achievement, and social relationships with family and peers. Child behavior problems and household food insecurity are all measured in the CDS. This study links the CDS to the PSID family-level datasets in order to obtain information on household characteristics, including household income, household head's education, and employment status.

The study sample includes CDS children who (1) were interviewed in both waves (N=2,907); (2) having household income of less than 200% of the federal poverty threshold (N=1,271); (3) have parents as their primary caregivers (N=1,079); (4) were age 3 or older in 1997 (N=873); and (5) have the quality of parenting and parent's mental health status collected in both waves (N=439).¹ The low-income criterion is used to account for potential confoundedness between food insecurity and

¹ Due to missing values on education status of household heads, only 416 CDS children are included in our final multivariate analyses.

household income. The CDS children younger than 3 in 1997 are excluded because data on possible behavior problems were not collected in wave I. The CDS children with non-parent caregivers are removed because parental characteristics cannot be identified for these cases. The final sample is 416 children from 249 households.

Measures

Child behavior problems. The dependent variable is child behavior problems. The 32-item behavior problem index (BPI) is adapted in the CDS from the scale developed by Peterson and Zill (1986). The index asks the primary caregiver whether a set of problem behaviors (e.g., having sudden changes in mood or feeling, being fearful or anxious, bullying, demanding excessive attention) is often, sometimes, or never true of their child. The BPI splits into two subscales, measuring externalizing or aggressive behaviors and internalizing, withdrawn or sad behaviors. Similar to Slack and Yoo (2005), we use these two subscales as the outcome variables of the study. The externalizing and internalizing subscales range from 0-17 and 0-15, respectively. A greater value on these scales indicates a higher level of behavior problems.

Household food insecurity. Household food insecurity, the main independent variable, is measured by a United States Department of Agriculture (USDA) 18-item scale.² This scale asks survey respondents about food-related experiences and behaviors in the last 12 months (e.g., “We worried whether our food would run out before we got money to buy more”). A continuous food insecurity score ranging from 0³ to 13 is computed for each household according to their responses. Higher scores suggest more severe levels of food insecurity. A categorical food insecurity measure (food secure vs. food insecure) can be created according to the continuous score.

The main analysis of the study uses the continuous household food insecurity score. The continuous measure is recommended for regression and correlation analysis by the USDA’s guide for measuring household food insecurity (Bickel, et al., 2000). Theoretically, food insecurity is a complex, multidimensional phenomena varying over a continuum. The continuous score captures the full range of food insecurity severity, and can produce greater “within variation” in repeated measures compared to the categorical measure. This advantage is important for our main analysis fixed-effects models which may have biased estimation with rarely changing variables (Beck, 2001) (See the Analytical Strategies section). The household food insecurity scale is included in CDS wave I, but not in wave II. Therefore, the second measure of food insecurity in this study is drawn from the PSID main files measured in 2001, collected one year earlier than the CDS wave II.

Parental characteristics. The mediator, parental characteristics, consists of quality of parenting and parents’ mental health status. All parental characteristics are collected from the primary caregiver of the child. Two indicators used to measure the quality of parenting are *parenting stress* and *parental warmth*. *Parenting stress* is measured by a seven-item index indicating the primary caregivers’ feelings and perceptions about caring for the child (e.g., “There are some things that (child) does that really bother me a lot”). The six-item *parental warmth* scale measures the warmth of the relationship

² This scale has 18 items for households with children and 10 for households without children (Bickel, Nord, Price, Hamilton, & Cook, 2000). Since our sample is drawn from households with children, we used the 18-item scale.

³ According to the measurement guide of this scale (Bickel, et al., 2000), households affirming none of 18 items are considered fully food secure, and are unidentified on the scale. In our study households affirming no items are coded as “0” instead.

between the child and parent in the month prior to the interview, including the frequency of showing physical affection, emotional support, and appreciation, and playing with the child or participating in the child's favorite activities. Developed by Child Trends, Inc. (Hofferth, Davis-Kean, Davis, Finkelstein, 1998), both of these scales range from 1 to 5 with higher scores indicating a greater degree of the measured constructs (stress and warmth). In addition to parenting stress and parental warmth, this study includes two measures of parent's mental health status—*psychological distress* (6 items) and parent's *self-esteem* (10 items). The psychological distress scale, ranging from 1 to 24, is developed by Ron Kessler (2002) to monitor general psychological distress. A Rosenberg scale, ranging from 1 to 4, is utilized in the CDS data to measure a global level of self-esteem. Higher values on these two scales mean higher levels of psychological distress and self-esteem, respectively. Details on the construction and psychometric properties of these measures can be found in the CDS-I user guide supplement (Hofferth, et al., 1998).

Other control variables. The control variables are selected following Slack and Yoo's model specification.⁴ This study has three groups of control variables: (1) household head's characteristics, including age, gender (male=1, female=0), schooling years, employment status (employed=1, others=0), and marital status (married=1, others=0);⁵ (2) household characteristics, including household size, number of children under 18 years old, log-transformed household income, and food stamp participation (participants=1, others=0); and (3) child characteristics, including age and disability status. A child's disability status is measured by whether a child has any physical or mental condition limiting childhood activities, school attendance, or schoolwork (yes=1, no=0). Household income and food stamp participation are used as the indicators of low socioeconomic status and food consumption (Slack & Yoo, 2005). Previous studies consistently find that low-income children or those in welfare programs have a higher prevalence of behavior problems (for example, Hofferth, Smith, McLoyd, & Finkelstein, 2000; McLoyd, 1998). These factors should be controlled for in analyses to examine the unique effects of food insecurity on behavior problems.

Analytical Strategies

The main analyses of the study are three fixed-effects models (see Table 3). In Model 1, the dependent variables (the externalizing and internalizing subscales of child behavior problems) are regressed on food insecurity, the control variables, and a dummy indicator of CDS data waves (wave I=0, and wave II=1). Parental characteristics (parenting stress, parental warmth, psychological distress, and self-esteem) are added into the regression in Model 2. Finally, parenting stress and parental warmth, two indicators for the quality of parenting, are regressed on food insecurity and control variables in Model 3. These three models are employed to test the mediation mechanism using regression (Baron & Kenny, 1986; Holmbeck, 1997).

While the first two models replicate Slack and Yoo (2005), our study additionally employs two waves of information and a fixed-effects estimator to avoid possible omitted variable bias caused by Slack

⁴ Due to the nature of the fixed-effects estimator used in the study, several time-invariant demographic variables (such as children's gender and race) were not controlled for in our models. Some other variables are rarely or slowly changing over time, and were excluded in our model as well. For instance, between two waves, only 96 children changed their schooling status, and that change is highly related to age change. Therefore, children's schooling status was not included in the model.

⁵ In the study sample, the household head is one parent of the CDS child, but can be a person different from the child's primary caregiver.

and Yoo's use of cross-sectional data in their Model 1. In our study, Model 1 tests the association between food insecurity and child's behavior problems. The use of cross-sectional data in the Model 1 of Slack and Yoo's (2005) study may lead to omitted variable bias. Unobserved time-invariant effects can be reasonably accounted for in the fixed-effects model, and food insecurity effects can be estimated more accurately in this study.

The results of Model 2 in Slack and Yoo (2005) show that the association between food insecurity and behavior problems may be spurious after including parental characteristics in the model. Slack and Yoo (2005) justify the effects of food insecurity by proposing a mediation mechanism: According to the FSM, they assume that food insecurity is a determinant of parental characteristics and conclude that parental characteristics are the mediators between food insecurity and behavior problems. This theory-driven interpretation does not rule out other potential explanations of the confoundedness between food insecurity and parental characteristics. The nature of the confoundedness between these two factors needs to be tested further. Therefore, this study uses Model 3 to examine the effects of food insecurity on parenting stress and parental warmth.

Among the four tested parental characteristics in Model 2, only parenting stress and parental warmth, two parenting indicators, are chosen as dependent variables in Model 3. Indicators of parent's mental health status, psychological distress, and self-esteem are not selected because an alternative explanation competing with the proposed mediation mechanism suggests that parent's mental health status could be the cause of food insecurity and child behavior problems.

Two strategies are used to test the robustness of the results from the fixed-effects models. First, using a lagged-dependent variable model, the dependent variables in wave II are regressed on a group of variables measured in wave I, including child behavior problems (previous dependent variable), mediators of parental characteristics, other control variables, and food insecurity. This test (see Table 4) examines the influence of food insecurity in the first wave on behavior problems in the second wave while controlling for prior behavior problems and parental characteristics. If earlier food insecurity is truly a determinant of behavior problems and has effects that last long enough, we should find a significant regression coefficient on food insecurity in the first wave.

Second, a propensity score variable, indicating the probability of having food insecurity in wave II, is estimated in a logit model by using information from the first wave. Child behavior problems in the second wave then are regressed on the dichotomous food insecurity, its propensity score, and other variables (see Table 5). The results of the propensity score approach are interesting for several reasons. While the fixed-effects estimator of the main analyses, a "within" estimator, explores how the change in food insecurity status of a household affects child behavior problems over time, the propensity score method performs like a "between" estimator, comparing the behavior problems of children with food insecurity to those without. Mediators of parental characteristics in the first wave are used to create the propensity score of food insecurity in the second wave, which helps us understand the confoundedness between food insecurity and parental characteristics.

Results and Discussion

Descriptive Statistics

Table 1 presents sample characteristics. Since the variables were measured twice for the study sample, these descriptive statistics are shown by wave, along with those for the full sample used in the main analyses of the fixed-effects models. In the sample, about 46% of the children are male and 30% are African-American. Both the externalizing and internalizing scale scores of child behavior problems increase between the two waves. A high proportion of children are living in female-headed households (about 44%); these household heads are in their mid-thirties and average less than 12 years of schooling. Nearly one-quarter of all household heads are not currently employed and slightly more than half are married. In the same way that child behavior problems increase from the wave I to wave II, three indicators of parental characteristics—parenting stress, parental warmth, and psychological distress—worsen between the two waves, while parents' self-esteem stays nearly the same. The measure of food insecurity indicates that the children and their households have lower levels of food insecurity in wave II, with the proportion of households with food insecurity decreasing from 27% to 23%. Nonetheless, household income remains low, around \$24,000, in the two waves. When adjusted for inflation, the average household income in the second wave is even lower than that of the first. However, the rate of participation in food stamp programs drops from 41% to 26% between the two waves.⁶

Bivariate Correlations

Table 2 presents correlations between the dependent variables and major independent variables. All correlation coefficients have expected directions—child behavior problems are positively related to food insecurity, parenting stress, and psychological distress, and negatively related to parental warmth and self-esteem. The magnitudes of the correlation coefficients between food insecurity and behavior problems (.15 with the externalizing subscale and .08 with the internalizing subscale) are much smaller than those between parenting stress and behavior problems (.47 and .36 respectively). Among the four indicators of parental characteristics, parenting stress has the strongest correlation with child behavior problems.

Results of Fixed-effects Models

The first two columns in Table 3 display the results of Model 1. As expected given the hypothesized mediation mechanism, without controlling for parental characteristics, food insecurity is positively related to both externalizing and internalizing behavior problems, statistically significant at the .1 and .05 level, respectively. The marginal effect of food insecurity is relatively small (.15 and .13 for the externalizing and internalizing scales, respectively). For instance, on average, the children with the highest 10% of food insecurity scale scores have a predicted externalizing problem score of 5.8 and those with the lowest 10% have a predicted score of 5.4—that is, only a .4 difference. In general, the results on food insecurity are consistent with those reported in Slack and Yoo (2005). The estimated

⁶ The difference in the food stamp participation rate might be a result of welfare reform. Previous studies showed that, after welfare reform, welfare recipients also exited the Food Stamp Program when leaving welfare, even though it is not required by the policy. The CDS wave I reported the Food Stamp participation rate before or around the 1996 PRWORA welfare reform, while wave II indicates the participation rate after the welfare reform.

regression coefficients of food insecurity here are smaller than their estimations for children aged 3-5, and greater than those for children aged 6-12, suggesting that the association between food insecurity and behavior problems may differ by child's age and developmental trajectory since the average child age in the sample is greater than 3 but less than 12. Other results of Model 1 bolster this point: As shown in Table 3, three age-related variables (CDS wave indicator, child's age, and head's age) are statistically significant in the model. Older children and children living with older parents are less likely to have behavior problems, when controlling for all other variables. Parents' employment has a positive impact on child behavior problems in this low-income sample. It may be that unemployment and the income shortage caused by unemployment is a substantial stressor leading to disrupted parenting behavior (Elder, Eccles, Ardel, & Lord, 1995; McLoyd, Jayaratne, Ceballo, & Borquez, 1994). In addition, household size is positively related to child's internalizing problems.

Consistent with Slack and Yoo's (2005) findings, the significance of household food insecurity disappears for both externalizing and internalizing behavior problems when parental characteristics are included in Model 2. The regression coefficient of food insecurity declines by about 50% in Model 2, which suggests that a great proportion of food insecurity effects on behavior problems are confounded with parental characteristics. All parental characteristics variables have expected direction of association; however, only parenting stress is statistically significantly associated with both dependent variables. Parent's self-esteem is negatively related to child's internalizing problems at the .1 significance level.

Assuming that household economic hardships may affect parental involvement in child development and thus have a negative influence on the interactions between parents and children, Model 3 uses food insecurity to predict parenting stress and parental warmth. Psychological distress and parent's self-esteem are not used as dependent variables (see the discussion in the analytic strategy section). As shown in Table 3, the other three parental characteristics are associated with parenting stress with expected directions, and only parental warmth is significantly correlated with parenting stress. More importantly, providing support to the mediation hypothesis, food insecurity also increases parental stress conditional on other control variables in the model; a one-point increase in the food insecurity scale is associated with a .04 unit increase of parenting stress. Our calculation by Sobel's (1982) test suggests the indirect effects of food insecurity on externalizing and internalizing problems through parenting stress are .07 ($p=.055$) and .04 ($p=.061$), respectively.

In summary, similar to Slack and Yoo (2005), the findings of Model 1 and 2 confirm the confoundedness of food insecurity and parental characteristics. Model 3 shows that food insecurity has a significant influence on parenting stress, supporting the proposed mediation mechanism.

Robustness Tests

In order to evaluate the robustness of the findings, two sets of tests are conducted. First, the lagged-dependent variable models are employed by regressing externalizing and internalizing behaviors measured in wave II on the continuous food insecurity score in wave I while controlling for the corresponding behavior problems measured in wave I (see columns 1 and 3 in Table 4). This model specification may provide some insights on the true relationship between food insecurity and behavior problems without decomposing the confoundedness between food insecurity and parental characteristics. Results indicate that food insecurity in wave I has little impact on behavior problems

in wave II in this model. One possible reason may be the nature of the CSD data; the time interval between the two waves may be longer than the duration for which food insecurity effects last.

To take the possibility into account that food insecurity effects may be short-term, the lagged-dependent variable model is rerun using food insecurity from wave II instead of wave I (see columns 2 and 4 in Table 4). In the lagged models using food insecurity in wave II, the regression coefficients of food insecurity increase substantially, and food insecurity has a significant association with externalizing behavior problems.

The second set of robustness tests adds a food insecurity propensity score variable in estimating the influence of food insecurity on behavior problems. Rather than the continuous variable used in the main fixed-effects models analysis, a dichotomous measure of food insecurity in wave II is used. The propensity score of food insecurity in wave II is predicted by wave I variables, including mediators of parental characteristics (parenting stress, parental warmth, psychological distress, and self-esteem). The results demonstrate that the dichotomous measure of food insecurity in wave II is not significantly associated with either externalizing or internalizing behavior problems. Meaning, for children with the same predicted probability of having food insecurity, the experience of food insecurity does not seem to lead to behavior problems. The inconsistency between our main analyses and robustness tests warrants further examination of the relationship between food insecurity and behavior problems.

Conclusion

This study contributes to the literature on material hardship and child well-being with a special focus on the relationship between food insecurity, parental characteristics, and child behavior problems. Our main analyses of fixed-effects models confirm a hypothesized mediation mechanism among these three constructs, supporting previous studies. Household food insecurity is a determinant of parental characteristics and child behavior problems according to fixed-effects models. However, the robustness tests present different stories; these results seem to favor alternative explanations of food insecurity and behavior problems other than the mediation mechanism. The disparities in findings imply that the effects of food insecurity on child behavior problems is more complicated than discussed in earlier research, and further examination is needed.

First, the results of the fixed-effects models with a continuous measure of food insecurity support the proposed mediation mechanism. With a smaller magnitude, the estimation of food insecurity effects was similar to that found to Slack and Yoo (2005). This is not surprising since the fixed-effects estimator controlled for the unobserved time-invariant factors. The estimated effects of food insecurity on this low-income sample are relatively small. According to the fixed-effects models, the effects of food insecurity on behavior problems are mainly mediated through parenting stress.

Second, the results from the lagged-dependent variable models raise the question whether the effects of food insecurity on behavior problems are short- or long-term. Household food insecurity in wave I did not impact behavior problems in wave II; however, significant effects of food insecurity are found if food insecurity measured in the later wave is used as an independent variable (Table 4). One possible explanation for the difference in these findings is that food insecurity effects may not last as long as expected. Another possibility is that food insecurity effects may be more serious for those with chronic food insecurity. The issue concerning duration of food insecurity impact and

chronic hardship experience suggests that interventions for behavior problems for children experiencing food insecurity should take the multiple aspects of food insecurity into account.

Third, since all proposed mediators of parental characteristics in wave I are used to create the propensity score variable of food insecurity, the results of the second robustness test might indicate that, with the same levels of parental characteristics as in the previous wave, food insecurity is not related to behavior problems. Contrary to the proposed explanation of a mediation mechanism, these results seem to favor an alternative explanation that long-term family backgrounds and parental characteristics—not short-term food insecurity—are the major factors contributing to child behavior problems. If the mediation mechanism explanation were correct, food insecurity in wave II should have had a significant impact on parental characteristics and child behavior problems, even when controlling for parental characteristics measured earlier. However, we did not find this to be the case in this robustness test.

Several limitations of this study should be noted. First, this study uses panel data from only two waves, which limits the capability of the study to examine child development trajectories in relation to time-varying household food insecurity. Longitudinal data with more waves of observations is needed to better understand the influence of food insecurity on child well-being. Second, the time interval between the two measures is quite long. Many factors could affect family background, food insecurity, parental characteristics, and child behavior problems between the two time points. Third, when using fixed-effects models, the estimation of variables that slowly change over time (such as demographic variables) may be less efficient or even biased (Beck, 2001). Finally, counterfactual models against the mediation mechanism proposed in the study are not fully explored. For example, Kleinman, et al. (1998) and Weinreb, et al. (2002) imply that parental characteristics, such as psychological distress, may be the cause of both household food insecurity and child behavior problems; for example, depressed parents may be less involved in food preparation and child development. In addition, parenting stress, the strongest predictor of child's behavior problems shown in this study and others (Ashiabi & O'Neal, 2007; Slack & Yoo, 2005), may actually have simultaneous or reciprocal effects on child behavior problems. That is, child behavior problems may increase parenting stress. Because estimation bias cannot be captured with the misspecification of the relationship between parenting stress and child behavior problems, our data does not allow us to further investigate this theory.

The findings of this study provide an illustration of the complications of poverty, material hardships, and family well-being. For low-income families, multiple factors including material hardships (i.e. food insecurity), family background, and parental characteristics may all be related to a child's outcomes. These issues are intertwined in the lives of families struggling with these difficult problems. A single intervention or interventions focusing on one issue might not be effective to improve the well-being of low-income children experiencing material hardships. Service providers working with families struggling with food insecurity should remain aware of the high risk of child behavior problems for this vulnerable population and address this issue as needed for the family.

In conclusion, building on previous literature (Ashiabi & O'Neal, 2007; Slack & Yoo, 2005), this study further investigates the links from food insecurity to parental characteristics to child outcomes and sheds light on the mechanisms with empirical evidence. Findings of the study suggest that the dynamic relationships of food insecurity, parental characteristics, and child behavior problems

cannot be captured in a simple way. This question should be further investigated with well designed data and diverse methodologies.

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Appendix

Table 1. Sample Characteristics (weighted)

Variables	Sample by wave		
	Full Sample (N=878) Mean or %	Wave I (N=439) Mean or %	Wave II (N=439) Mean or %
Children demographic characteristics			
Gender: male (%)	45.67	45.67	45.67
Race: African-American (%)	29.64	29.64	29.64
Age	9.53 (3.55)	7.45 (2.87)	11.61 (2.88)
Disability status (%)***	87.29	80.43	94.16
Children's behavior problems			
Externalizing scale**	5.53 (4.02)	5.27 (3.53)	5.81 (4.46)
Internalizing scale***	2.98 (3.00)	2.41 (2.41)	3.56 (3.39)
Household heads' characteristics			
Gender: female (%)	43.91	41.21	44.52
Age	36.85 (7.34)	34.86 (6.98)	38.83 (7.17)
Education: schooling years	11.13 (2.92)	11.03 (3.02)	11.22 (2.89)
Employment: not employed (%)*	25.02	27.56	22.49
Marital status: married (%)	53.02	55.67	50.37
Parental characteristics			
Parenting stress***	2.16 (.77)	1.95 (.64)	2.38 (.83)
Parental warmth***	4.07 (.73)	4.37(.60)	3.76 (.71)
Psychological distress**	4.65 (4.06)	4.32 (3.99)	4.99 (4.10)
Parent's self-esteem	3.31 (.45)	3.32 (.47)	3.31 (.44)
Household characteristics			
Food insecurity status			
Continuous score (household level)	1.59 (2.33)	1.68 (2.49)	1.50 (2.17)
Dichotomous measure (% , household level)	25.13	27.02	23.24
Household income (thousands)	24.29 (14.45)	24.07(16.52)	24.51 (12.04)
Household size	4.53 (1.43)	4.54 (1.43)	4.54 (1.44)
Number of children	2.78 (1.22)	2.80 (1.24)	2.76 (1.20)
Food stamp participation (%)***	33.31	40.66	25.95

Standard deviation is listed in parentheses. Asterisks in table indicates significant difference between two waves (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$).

Table 2. Correlations of Dependent Variables and Major Independent Variables (weighted)

Variables	2	3	4	5	6	7
1. Externalizing behaviors	.62	.15	.43	-.11	.26	-.17
2. Internalizing behaviors		.08	.36	-.17	.32	-.27
3. Food insecurity scale			.16	-.05	.16	.27
4. Parenting stress				-.25	.36	-.32
5. Parental warmth					-.10	.18
6. Parental psychological distress						-.47
7. Parent's self-esteem						1.00

All correlation coefficients except the one between food insecurity and parental warmth are statistically significant at .001 level.

Table 3. Results of Fixed-effects Models: Behavior Problems, Food Insecurity and Parental Characteristics

Variables	Model 1		Model 2		Model 3	
	Externalizing	Internalizing	Externalizing	Internalizing	Parenting stress	Parental warmth
Food insecurity	0.15*	0.13**	0.07	0.07	0.04*	0.01
	(0.08)	(0.06)	(0.08)	(0.06)	(0.02)	(0.01)
Parenting stress			1.80***	1.06***		-0.09*
			(0.26)	(0.20)		(0.05)
Parental warmth			-0.37	0.24	-0.12*	
			(0.30)	(0.22)	(0.07)	
Psychological distress			0.06	0.04	0.03***	-0.00
			(0.04)	(0.03)	(0.01)	(0.01)
Parent's self-esteem			-0.13	-0.58*	-0.21**	-0.04
			(0.39)	(0.31)	(0.09)	(0.07)
Control Variables						
Child's age	-1.13**	-0.89**	-0.78*	-0.63	-0.11	0.01
	(0.48)	(0.42)	(0.46)	(0.41)	(0.09)	(0.07)
Child's disability status	0.36	0.28	-0.06	-0.02	0.20*	0.05
	(0.60)	(0.56)	(0.56)	(0.53)	(0.11)	(0.09)
Head's gender (female)	-0.24	-0.02	-0.47	-0.44	0.25	0.53***
	(1.06)	(0.78)	(0.94)	(0.72)	(0.19)	(0.17)
Head's age	-0.20***	-0.05	-0.17***	-0.04	0.00	0.01
	(0.08)	(0.07)	(0.06)	(0.06)	(0.01)	(0.01)
Head's employment (yes)	-0.75*	-0.59*	-0.74*	-0.60*	0.08	-0.00
	(0.40)	(0.33)	(0.40)	(0.32)	(0.09)	(0.06)
Head's education	0.05	-0.02	0.02	-0.04	0.01	-0.00
	(0.16)	(0.19)	(0.18)	(0.20)	(0.04)	(0.04)
Head's marital status	0.57	0.06	0.56	-0.10	0.12	0.34**
	(0.97)	(0.69)	(0.88)	(0.64)	(0.16)	(0.13)
Log-household income	-0.00	-0.05	0.02	-0.06	-0.00	0.04*
	(0.11)	(0.10)	(0.08)	(0.10)	(0.02)	(0.02)
Household size	0.24	0.52**	0.17	0.46*	-0.01	0.04
	(0.36)	(0.24)	(0.34)	(0.24)	(0.06)	(0.05)
Number of children	-0.08	-0.10	-0.01	-0.02	-0.01	-0.09
	(0.37)	(0.27)	(0.35)	(0.27)	(0.07)	(0.06)
Food Stamp participation	-0.46	-0.10	-0.22	0.10	-0.06	-0.03
	(0.41)	(0.35)	(0.39)	(0.34)	(0.08)	(0.06)
Wave indicator	5.94***	4.77***	3.50*	3.46**	0.72*	-0.68**
	(2.07)	(1.79)	(2.00)	(1.75)	(0.38)	(0.32)
Observations	821	821	821	821	821	821
R-squared	0.07	0.11	0.21	0.20	0.25	0.45

*** p<0.01, ** p<0.05, * p<0.1 (Robust standard errors in parentheses).

Table 4. Robustness Test: Lagged-Dependent Variable Models

Independent Variables	Dependent Variables			
	Externalizing scale in Wave II		Internalizing scale in Wave II	
Food insecurity in Wave I	-0.03 (0.10)		0.02 (0.08)	
Food insecurity in Wave II		0.22* (0.13)		0.17 (0.11)
Externalizing scale in Wave I	0.51*** (0.08)	0.51*** (0.07)		
Internalizing scale in Wave I			0.53*** (0.08)	0.54*** (0.08)

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$ (Robust standard errors in parentheses).

Table 5. Robustness Test: Regression Models with Propensity Score Variable

Independent Variables in Wave II	Dependent Variables in Wave II			
	Externalizing Scale		Internalizing Scale	
Dichotomous food insecurity	.31 (.80)	.00 (.78)	-.40 (.83)	-.63 (.67)
Parenting stress		2.39*** (.33)		1.27*** (.26)
Parental warmth		-.30 (.46)		.24 (.37)
Psychological distress		.09 (.08)		.08 (.07)
Parent's self-esteem		-.01 (.75)		-1.47* (.70)
Propensity score of food insecurity in Wave II	4.23** (2.10)	1.65 (2.25)	2.49 (2.29)	.90 (2.57)

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$ (Robust standard errors in parentheses).