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of childhood food insecurity**

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The Long-term Health Consequences of Childhood Food Insecurity

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The Long-term Health Consequences of Childhood Food Insecurity

Abstract

This study examined the long-term consequences of frequency, timing, and severity of food insecurity exposure in childhood on health and health care utilization in adulthood using nearly 20 years of data from the Panel Study of Income Dynamics. The findings provide evidence of the long-lasting health effects of childhood food insecurity. Young adults who experienced food insecurity as children have higher psychological distress, even when adjusting for childhood socioeconomic status, parent's health, health during childhood, and food insecurity during adulthood. More severe and more frequent episodes of childhood food insecurity are related to worse psychological distress during adulthood, but even marginal food security and single episodes of food insecurity appear to be related to worse psychological distress during adulthood. Very low food security during childhood also appears to be related to worse physical health during adulthood. Using instrumental variables to adjust for selection into the Supplemental Nutrition Assistance Program (SNAP), this study also finds some evidence that receipt of SNAP during childhood appears to reduce the effects of childhood food insecurity on health during adulthood.

The Long-term Health Consequences of Childhood Food Insecurity

Executive Summary

Background and Purpose. In 2015, 18 percent of American children under age 18 lived in households that experienced food insecurity at some point during the year (Coleman-Jensen, Rabbitt, Gregory, & Singh, 2016). Research indicates that food insecurity in children is associated with serious health, behavioral, and cognitive problems (see Gundersen & Ziliak (2015) for a recent review). Because few data sources that track food insecurity and health also follow the same individuals over time, most prior studies have focused on identifying concurrent relationships between food insecurity and health. To contribute to the literature on the long-term health consequences of childhood food insecurity, this study used nearly 20 years (1996 to 2015) of the Panel Study of Income Dynamics (PSID) to examine the long-term consequences of the frequency, timing, and severity of food insecurity exposure in childhood on health and health care utilization in adulthood. This study also examined whether childhood food insecurity has an independent effect on adult health when a) childhood health was held constant, or b) when adult food insecurity was held constant. Finally, this study investigated whether participation in the Supplemental Nutrition Assistance Program (SNAP) during childhood has any long-term health benefits.

Data and Methods. This study used all three waves of the Child Development Supplement (CDS) (1997, 2002 and 2007), six waves of the Transition to Adulthood Study (TAS) (2005, 2007, 2009, 2011, 2013, and 2015), and six waves of the Main Family File (MFF) (1996, 1997, 1999, 2001, 2003 and 2015) of the PSID. The analysis sample is restricted to CDS children who have completed at least one MFF or TAS survey as an adult (age \geq 18) and who either reported food insecurity in at least one wave between 1997 and 2003 (n= 1312) or had an income below 250% of the federal poverty level in at least one wave between 1997 and 2003 (n=773). Regression models were used to estimate the relationship between

childhood food insecurity and adult health outcomes. Adult health outcomes examined included self-reported health status, body mass index (BMI), the number of chronic conditions, a psychological distress score, a mental health diagnosis, and the number of days hospitalized in the last year. Because children that experience food insecurity usually have multiple risk factors for poor health, the following controls were included: child's birthweight, child's health insurance coverage, child's age, child's gender, child's race/ethnicity, parents' health, parents' age, parents' education, parents' marital status, household composition, total family income, parents' employment status, home ownership, rural residence, and average state unemployment rate experienced by the household between 1996-2002.

Findings. The findings from this study provide evidence of the long-lasting health effects of childhood food insecurity. Young adults who experienced food insecurity as children have higher psychological distress, even when adjusting for childhood socioeconomic status, parent's health, health during childhood, and food insecurity during adulthood. More severe and more frequent episodes of childhood food insecurity are related to worse psychological distress during adulthood, but even marginal food security and single episodes of food insecurity appear to be related to worse psychological distress during adulthood. Very low childhood food security also appears to be related to worse physical health during adulthood. The findings do not support the idea that childhood health is an important mediator, but rather that the intergenerational transmission of food insecurity may play a role in the relationship between childhood food insecurity and adult health. Finally, I find that receipt of SNAP benefits during childhood is associated with higher adult BMI within the normal range of BMIs and may reduce the effects of childhood food insecurity on reducing BMI and increasing psychological distress in adulthood.

Policy Implications. This evidence suggests that the increase in food insecurity experienced by American households starting in 2007 will likely lead to long-lasting increases in psychological distress. On the other hand, the findings suggest that the prevention of childhood food insecurity and provision of SNAP benefits may have long-lasting effects on population health and health care spending.

The Long-term Health Consequences of Childhood Food Insecurity

Introduction

In 2015, 18 percent of American children under age 18 lived in households that experienced food insecurity at some point during the year (Coleman-Jensen et al., 2016). Research indicates that food insecurity in children is associated with serious health, behavioral, and cognitive problems (see Gundersen & Ziliak (2015) for a recent review). Because few data sources that track food insecurity and health also follow the same individuals over time, most prior studies have focused on identifying concurrent relationships between food insecurity and health. Two notable exceptions are Kirkpatrick, McIntyre, Potestio, McIntyre, & Potestio (2010), which uses 10 years of the Canadian National Longitudinal Survey of Children and Youth, and Ryu & Bartfeld (2012), which uses 9 years of the Early Childhood Longitudinal Study-Kindergarten Cohort. Both studies found that having multiple episodes of food insecurity in childhood is associated with lower health status in later years, but only one (Kirkpatrick et al., 2010) demonstrates an association between *any* episode of food insecurity during childhood and poor health in the future. In addition, Hoynes, Schanzenbach, & Almond (2016) use the Panel Study of Income Dynamics (PSID) and find access to the food stamp program during childhood improves later life health among the cohorts born between 1956 and 1981, supporting the notion that food insecurity in childhood affects long-term health.

We know childhood health has lasting effects on adult health and circumstances (Case, Fertig, & Paxson, 2005). Thus, many predict that if food insecurity is associated with childhood health then it will also be associated with adult health through its impact on child health (Cook & Jeng, 2009). However, childhood food insecurity may also affect adult health through other means independent of its impact on child health. First, restrictions in nutrition during certain child developmental phases may cause long-term damage that does not show up until later in life (Hanson & Gluckman, 2011; Wachs,

Georgieff, Cusick, & McEwen, 2013). For example, Hoynes et al. (2016) find that access to food stamps prior to age 5 has a larger effect on adult health than access after age 5. Second, parental health or household behaviors that develop because of food insecurity may have long-term impacts on children's health (Kalmakis & Chandler, 2015). Thus, further evidence is needed to know how best to protect children from any long-term health consequences stemming from food insecurity.

To contribute to the literature on the long-term health consequences of childhood food insecurity, this study used interviews from supplements of the PSID spanning nearly 20 years (1996 to 2015) to examine the long-term consequences of frequency, timing, and severity of food insecurity exposure in childhood on health and health care utilization. This study also examined whether childhood food insecurity has an independent effect on adult health when a) childhood health was held constant, or b) when adult food insecurity was held constant. Finally, this study investigated whether participation in the Supplemental Nutrition Assistance Program (SNAP) during childhood has any long-term health benefits. The main contributions of this study are the examination of longer-term effects of food insecurity and actual SNAP participation (vs. access) than previously possible, and the inclusion of a large variety of adult health outcomes.

Data

This study used all three waves of the Child Development Supplement (CDS) (1997, 2002 and 2007), six waves of the Transition to Adulthood Study (TAS) (2005, 2007, 2009, 2011, 2013, and 2015), and six waves of the Main Family File (MFF) (1996, 1997, 1999, 2001, 2003 and 2015) of the PSID. The analysis sample is restricted to CDS children who have completed at least one MFF or TAS survey as an adult (age \geq 18) and who either experienced food insecurity in at least one wave between 1997 and 2003 (n=1312) or had an income-to-needs ratio below 2.5 (i.e., they had an income below 250% of the federal poverty level) in at least one wave between 1997 and 2003 (n=773). For some analyses, the CDS

children were divided into two similar-sized age groups: those from birth to age 5 in 1997 (who are between the ages of 18 and 23 in 2015), and those between the ages of 6 and 12 in 1997 (who are between the ages of 24 and 31 in 2015).

Table 1 provides demographic, birth and baseline characteristics of the sample by childhood food insecurity exposure. From these statistics, it is clear that children from food insecure families have more socioeconomic disadvantages than children from low-income but food secure families. The food insecurity sample contains a higher fraction of black and Hispanic children than the low-income, food secure sample. The children in the food insecure sample were more likely to have their birth paid for by Medicaid, but are less likely to have health insurance in 1996 (reported in the 1997 CDS). Compared to the food secure sample, mothers in the food insecure households are more likely to have fair or poor self-reported health status, have lower average completed education, and are less likely to be married. The food insecure households have a greater number of children, have a much lower annual income, are less likely to have a working head of household, and are less likely to own their home. Food insecure households are less likely to live in rural areas than food secure households. Finally, food insecure families live in states with slightly (but statistically significantly) higher unemployment rates.¹

Childhood Food Insecurity Measures. Childhood food insecurity is captured at four time points for children participating in the CDS: in the 1997 CDS, and in the 1999, 2001 and 2003 MFF. The PSID asks 18 questions about household food security for households with children; a food security scale is created by summing the affirmative responses of these 18 questions. Severity of food insecurity is assessed by the average food security scale during childhood and by indicators that separate this scale into marginal (1-2), low (3-7) and very low food security (8-18). The frequency of food insecurity was assessed by a count of the number of food insecurity episodes of any severity (the maximum possible

¹ Data on annual state unemployment rates come from the University of Kentucky's Center for Poverty Research National Welfare Data(University of Kentucky Center for Poverty Research, 2016).

number of episodes is 4). The timing of food insecurity was captured by average food security scale scores between the ages of 0-5 (preschool), 6-12 (elementary) and 13-18 (teen). For the younger cohort of children (birth to age 5 in 1997), only food insecurity in the preschool and elementary age categories was observed; for the older cohort of children (age 6-12 in 1997), only elementary and teen age food insecurity was observed.

Table 2 provides descriptive statistics of the childhood food insecurity experience of the sample with any food insecurity exposure (n=1312). The average food security score among those in the food insecure sample was about a two (i.e., two affirmative responses to the 18 questions, or marginally food secure). 60% of the those with any food insecurity exposure had at least one episode of low or very low food security where 40% only experienced marginal food security. 19% experienced very low food security at least once. 41% reported food insecurity at only one of the four possible interviews; 26% reported food insecurity at 2 of the 4 interviews; 22% reported food insecurity at 3 of the 4 interviews; and 12% reported food insecurity at all 4 interviews. 87% of food insecure households were observed at all four waves. 30% of those with any food insecurity exposure had only one episode of low or very low food security and 13% had only one episode of very low food security. 30% experienced multiple episodes of low or very low food security but only 6% experienced multiple episodes of very low food security. Finally, the average food security score for the three age categories examines (birth to 5, 6 to 12, and 13 to 18) was 2, the average for the full sample across all ages.

Table 3 shows that the socioeconomic disadvantages of families increase with the severity and frequency of food insecurity experienced. Families that experienced multiple episodes of food insecurity are more likely to be black and Hispanic than families that experienced only one episode of food insecurity. The children who experienced more severe or more frequent episodes of food insecurity were more likely to have their birth paid for by Medicaid, but are less likely to have health insurance in 1996. Mothers experiencing more severe or more frequent episodes of food insecurity are

more likely to have fair or poor self-reported health status, have lower average completed education, and are less likely to be married. Households experiencing more severe or more frequent episodes of food insecurity have a greater number of children, have a much lower annual income, are less likely to have a working head of household, and are less likely to own their home. Severity and frequency of food insecurity is significantly associated with rural residence. Finally, households experiencing more frequent episodes of food insecurity live in states with higher unemployment rates.

Outcome Measures. Extensive health information about the sample children were captured through follow-up CDS interviews (until they reach age 18), then TAS interviews (starting at age 18), and then from the main family file (if they start their own split-off household). The specific health outcomes examined included self-reported health status, body mass index (BMI), presence of chronic conditions (asthma, diabetes, high blood pressure, and cancer), and mental health problems (captured by a self-reported mental health diagnosis and non-specific K6 psychological distress (Kessler et al., 2002) scores). Health care utilization was measured by number of days hospitalized. When adult health is observed in multiple years, the observation observed at the oldest age was used.

Table 4 shows that the average health outcomes in the sample are rather poor. The average self-reported health status is only between very good (2) and good (3). The average BMI is in the overweight range (>25), the average number of chronic conditions (asthma, diabetes, high blood pressure or cancer) is about 0.3, and the average number of hospitalizations in the last year is about 0.3. The young adults (age 18-31) who experienced more severe forms of food insecurity as a child rate their health significantly worse, are more likely to have a psychological diagnosis, and have more hospitalizations than those without food insecurity, but otherwise appear to have the same average health outcomes as young adults who were low-income but food secure in childhood. Children who experienced multiple episodes of food insecurity do not have significantly different average health as young adults compared to children who only experienced one episode of food insecurity.

Mediating Measures. Childhood health measures and adult food insecurity are examined as possible mediating factors contributing to the relationship between child food insecurity and adult health. Childhood health measures are available at each of the three CDS interviews. The primary caregiver provides a rating of the child's overall health status from excellent to poor, provides the child's height and weight, answers a series of questions about health conditions that a doctor or health professional has ever said that the child had (e.g., asthma, a serious emotional disturbance), and answers a question about whether the child has ever seen a psychiatrist, psychologist, doctor or counselor about an emotional, mental or behavioral problem. From these responses, I created a measure of the worst child health rating observed in the three interviews (1997, 2002 and 2007), the child's oldest observed percentile BMI (given their age and sex) before age 18, a measure of whether the child was reported to have ever had an emotional problem (either a diagnosis or saw a doctor about a problem), and measures of whether the child was reported to ever have an asthma diagnosis.

After 2003, the first time food insecurity questions were asked again in the PSID was at the 2015 MFF so adult food insecurity is assessed by this one measurement. To ensure that adult food insecurity does not merely capture adult socioeconomic status, I also included a control for poverty status in 2015 when including an indicator for adult food insecurity.

Table 5 indicates that the children who experienced more severe or more frequent episodes of food insecurity were more likely to be rated in fair or poor health as children. Children were also more likely to have an emotional problem if they experienced more severe or more frequent episodes of food insecurity. The other child health outcomes (weight status, and asthma) were not related to food insecurity. Children who experienced food insecurity were roughly twice as likely to be food insecure in 2015 than the low-income children who were food secure. Similarly, children who experienced food insecurity were also more likely to live in poverty in 2015 as adults. Severity and frequency of the food insecurity during childhood was also highly related to food insecurity and poverty as an adult.

SNAP Participation. Participation in the Food Stamp Program (what SNAP was called prior to 2008) was accessed in every month of the year in the MFFs. We summed the number of months that the respondent or anyone in the household received food stamps between January 1996 and December 2002 to correspond to the child food insecurity observation window. We also created an indicator for whether the household received any food stamps in this window. Table 5 indicates that SNAP participation was 28% among the food secure sample, 44% for those experiencing marginal food security, 62% for those experiencing low food security, and 76% among those who experienced very low food security. The duration of SNAP receipt increases with the severity and frequency of food insecurity experienced ranging from 8 months among the food secure to 29 months (out of 84 possible months) among those who experienced very low food security.

Instruments for SNAP participation. Because households that experience more severe forms of food insecurity are more likely to participate in SNAP (as shown in Table 5) and are more disadvantaged in many ways (as shown in Table 3), households that choose to participate in SNAP may be in worse health than those who do not participate in SNAP. To adjust for this selection bias, state- and time-varying SNAP program rules are used to identify exogenous variation in SNAP participation following Ratcliffe, McKernan, & Zhang (2011). Program rules that are strong instruments for SNAP participation but do not directly lead to different adult health outcomes include: full immigrant eligibility, partial immigrant eligibility, simplified reporting of changes, and vehicle exclusions from asset tests. Full and partial immigrant eligibility indicates that all (full) or some (partial) legal working age adult non-citizens in a state are eligible for federal SNAP benefits or state-funded food assistance if they satisfy the other eligibility requirements. Simplified reporting indicates that the state uses a simplified reporting option for households with earnings that reduces requirements for reporting changes in household circumstances. Finally, vehicle exclusions indicate that the state excludes at least one vehicle or excludes a higher amount than the standard auto exemption from the SNAP asset test for eligibility. All

of these policies lower the barriers to participation in SNAP in that state and thus should increase the likelihood of participation. First stage results (See Appendix Table 1) indicate that vehicle exclusions are positively associated with SNAP participation as expected. However, full and partial immigrant eligibility and simplified reporting are negatively associated with SNAP participation, which may suggest that some states with low participation rates may have instituted these policies earlier than states with higher participation rates. The instruments are jointly significant in the first stage at $p < 0.001$ and the first stage has F statistics of 56 and 64 (see Appendix Table 1).

Data on the SNAP program rules come from the SNAP Policy Database provided by the U.S. Department of Agriculture (USDA) Economic Research Service (Economic Research Service, 2018). This database includes program rules on every state including DC for every month between January 1996 through December 2016. The percent of months that each state has each policy in each year between 1996 and 2002 was merged to the PSID data by state and year. About 8% of sample households lived in multiple states over this period so the policy variables followed households across states. The percent of months between January 1996 and December 2002 that each household lived in a state with each policy was calculated. The SNAP policy measures in each state over this period were used as instruments for whether a household participated in at least one month of SNAP and the logarithm of the number of months of SNAP participation between January 1996 and December 2002.

Research Methods

To estimate the relationship between child food insecurity (CF) on adult health outcomes (AH), the following model was used.

$$AH_i = \alpha_0 + \beta_0 CF_i + \gamma_0 X_i + \varepsilon_i \quad (1)$$

Because children that experience food insecurity usually have multiple risk factors for poor health, the following controls (X) are included: child's birthweight, child's health insurance coverage, child's age,

child's gender, child's race/ethnicity, parents' health, parents' age, parents' education, parents' marital status, household composition, total family income, parents' employment status, home ownership, rural residence, and the average annual state unemployment rate experienced by the household between 1996 and 2002.

To estimate whether childhood health or adult food insecurity (MF) mediated the relationship between child food insecurity and adult health, the following model was used.

$$AH_i = \alpha_1 + \beta_1 CF_i + \gamma_1 X_i + \delta_1 MF_i + \varepsilon_i \quad (2)$$

To estimate the effect of household SNAP participation during childhood on adult health outcomes, an instrumental variables approach is used to adjust for selection into SNAP. The first stage equation predicts SNAP participation (SNAP*) using the instruments described above (Z) and the individual/household-level characteristics (X) used as controls in equations (1) and (2).

$$SNAP_i^* = \theta_0 + \theta_1 Z_i + \theta_2 X_i + \mu_i \quad (3)$$

SNAP participation predicted in the first equation is then used to estimate the effect of SNAP participation on adult health outcomes, controlling for average food insecurity in childhood, which further adjusts for selection into the program.

$$AH_i = \alpha_2 + \pi_2 SNAP_i^* + \beta_2 CF_i + \gamma_2 X_i + \varepsilon_i \quad (4)$$

For equations (1) and (2), logit models were estimated for the binary dependent variable (psychological diagnosis), ordered logits were estimated for ordered categorical dependent variables (health rating, number of chronic conditions, psychological distress score, and number of hospitalizations), and ordinary least squares was estimated for the continuous dependent variable (BMI). For the instrumental variable equations (3) and (4), I used a linear two stage least squares model for all dependent variables. Because multiple comparisons are conducted, I expect to see 5 percent of

them to show significant results at random, thus the number of comparisons is taken into account when drawing conclusions. In all models, standard errors are adjusted for intra-cluster correlations at the 1968 family level.

Given the preponderance of evidence that food insecurity is associated with poor health in the short-term and that poor child health leads to poor adult health outcomes, the hypothesis is that childhood food insecurity is significantly and positively related to poor adult health outcomes ($\beta > 0$). More severe episodes of food insecurity will likely have greater effects than marginal food security. Multiple episodes of food insecurity will also likely have greater effects than single episodes of food insecurity, but given that a large fraction of the population experiences food insecurity at one point in time, it is important to know if, and under what circumstances, it has non-zero effects. I hypothesize that food insecurity at younger ages will have a greater impact on long-term health than at older ages given the findings from Hoynes et al. (2016). I expect that child health and adult food insecurity will explain some of the relationship between childhood food insecurity and adult health ($\beta_0 > \beta_1$). Finally, I expect that SNAP participation, adjusting for selection, is significantly and negatively related to poor adult health outcomes ($\pi < 0$).

Results

Childhood food insecurity and adult health. Tables 6, 7 and 8 show the results of regressions estimating the relationship between severity (Table 6), frequency and severity (Table 7), and the timing (Table 8) of food insecurity. Those young adults with higher average food insecurity scores during childhood had a significantly higher psychological distress (K6) score, a higher probability of having a mental health diagnosis, and a slightly higher number of days in the hospital than young adults with lower childhood food security scores. Young adults who experienced food insecurity of any severity at least once during childhood had a significantly higher psychological distress (K6) score than young adults

from low-income but food secure childhood families. The coefficient is larger for adults who experienced more severe forms of food insecurity during childhood. Adults who experienced low or very low food security in childhood were also more likely to rate their overall health status slightly worse than those without childhood food insecurity. Finally, young adults who experienced very low food security at least once during childhood have more chronic conditions and hospitalizations, and were more likely to have a mental health diagnosis compared to young adults who did not experience food insecurity as children.

Similarly, young adults who experienced food insecurity multiple times during childhood had a significantly higher K6 score and a higher chance of having a mental health diagnosis than those who were food secure as children (top two panels of Table 7). However, even one episode of food insecurity (all three panels of Table 7) and those only experiencing marginal food security (middle panel of Table 7) have significantly higher psychological distress scores in adulthood. Children who experienced low or very low food security one time during childhood had a higher K6 score and more hospitalizations as a young adult (bottom two panels of Table 7). In addition, children who experience very low food security one time have a higher probability of mental health diagnosis as an adult. Finally, children who experienced multiple episodes of very low food security have a slightly higher number of chronic conditions during adulthood.

Table 8 shows the relationship between average food insecurity during specific age ranges on adult health outcomes. Because children in the sample are observed in at most two of the three age ranges, to include all three age ranges in one regression, I set the averages equal to 0 if they were not observed and included indicator dummy variables for when the average was set to 0. I also included separate regressions using only those age birth to 5 in 1997 (who all have observations in the youngest two age ranges) and then only those age 6 to 12 in 1997 (who all have observations in the oldest two age ranges) without any imputed averages. Results indicate that average food security scores between birth and

age 5 are significantly associated with a lower BMI in adulthood. Average food security scores when age 6-12 are significantly related to higher K6 scores in adulthood, and marginally related to the number of chronic conditions, BMI, and having a mental health diagnosis in adulthood. Finally average food security scores when age 13-18 are significantly associated with having a mental health diagnosis and marginally related to a higher K6 score. Thus, food insecurity during any of the three age groups examined (birth to age 5, age 6-12, and age 13-18) is significantly related adult health.

Are childhood health or adult food insecurity potential mediators? Tables 9 and 10 present the results about whether childhood food insecurity has an independent relationship with adult health outcomes when childhood health (Table 9) or adult food insecurity (Table 10) is controlled for. For comparison purposes, I show results with and without the additional controls on the same sample. In Table 9, I include all of the child health measures described in Table 5. The primary caregiver's fair or poor rating of the child's health is positively and significantly related to the number of chronic conditions and having a mental health diagnosis as a young adult. Being overweight or obese as a child is positively and significantly related to their self-reported health status, their BMI, and the number of chronic conditions as an adult. The childhood emotional problem indicator is positively and significantly related to their K6 score, the probability of a mental health diagnosis, and the number of hospitalizations as an adult. Asthma as a child is significantly related to the number of chronic conditions (one of which is asthma) in adulthood.

The coefficients on the average childhood food security score without the child health controls are slightly different than those shown in Table 6 because of the change in sample size due to missing observations on child health for some children; in particular, the relationships between food security and having a mental health diagnosis and number of hospitalizations are no longer significant. Regardless, the inclusion of the child health controls only a small effect, if any, on the coefficients on the average childhood food security score in the case of the number of chronic conditions and the K6 score.

The coefficient in column (6) is marginally significant where it is not in column (5) suggesting that childhood food insecurity may be related to the number of chronic conditions when child health conditions are held constant. In contrast, the coefficient in column (8) is slightly smaller than in column (7), although not significantly different given the size of the standard errors. Thus, it appears that childhood food insecurity has a relationship with adult health (particularly psychological distress) that is mostly independent of childhood health.

The results in Table 10 indicate that adult food insecurity has a strong positive and significant association with all of the adult health measures except BMI. Poverty in adulthood is significantly related to mental health diagnoses and hospitalizations. The inclusion of these controls has a small effect on the coefficients on the average childhood food security score for the mental health outcomes. Yet, childhood food insecurity still has a significant effect on psychological distress that is mostly independent of their adult food insecurity and poverty status. The intergenerational transmission of food insecurity and poverty may partially explain the effect of childhood food insecurity on mental health. Because adult food insecurity and the adult health outcomes are observed at the same point in time, it may also be that adult mental health problems lead to food insecurity so the direction of causality of this mechanism is not clear.

SNAP participation and adult health outcomes. Results from the instrumental variable estimation of SNAP participation on adult health outcomes, adjusting for selection into SNAP, finds a significant and positive relationship between SNAP participation during childhood and adult BMI. In supplemental analyses (not shown), I find that SNAP participation during childhood is not associated with having a BMI over 25 (overweight or obese), thus SNAP appears to increase BMI within the normal range of BMIs. The coefficients on SNAP participation are negative with respect to all of the adult health outcomes except BMI, but none of those coefficients are even marginally statistically significant.

The results also indicate that SNAP participation may affect the relationship between food insecurity and adult health. The coefficients on the average food security score are marginal significantly negative with respect to BMI in Table 11 but not in Table 6 suggesting that holding SNAP participation fixed, childhood food insecurity may be related to lower BMI in adulthood. In addition, the coefficients on the average food security score with respect to the K6 scores are larger in magnitude when SNAP participation is in the model than in Table 6. This suggests that SNAP participation may reduce the effect of childhood food insecurity on adult psychological distress.

Discussion

The findings of this study suggest that childhood food insecurity increases the likelihood individuals experience psychological distress as young adults. Even marginal food security or one episode of food insecurity during childhood has significant effects on adult psychological health. However, more severe or frequent episodes of childhood food insecurity are more strongly related to higher psychological distress in young adulthood. Childhood experiences of very low food security are also associated with worse ratings of self-reported health status, a greater likelihood of having a chronic condition, and more hospitalizations in adulthood.

Findings regarding the relationship between the timing of the food insecurity exposure appear to indicate that food insecurity at younger ages (between birth and age 5) may be related to adult BMI while food insecurity at older ages (ages 6-12 and ages 13-18) may be related to mental health problems. Thus, while Hoynes et al. (2016) suggest that food access before age 5 is more important for adult health (specifically metabolic syndrome) than access after age 5, these results indicate that food insecurity at any age has an impact on adult health.

The findings also suggest that a possible mechanism connecting childhood food insecurity with adult health is the intergenerational transmission of food insecurity. Individuals who experience food

insecurity as children are more likely to experience food insecurity as adults (Table 5), and adult food insecurity is highly related to psychological distress (Table 10). However, even controlling for adult food insecurity, childhood food insecurity still has a significant association with both physical and mental health problems in adulthood (Table 10). In contrast, it does not appear that childhood health mediates the relationship between childhood food insecurity and adult health. The relationship between childhood food insecurity and adult health appears mostly independent of childhood health measures (Table 9).

Finally, the results indicate that SNAP participation during childhood does not appear to directly affect health outcomes in adulthood, with the exception of BMI. It does appear that SNAP participation reduces the negative effect of food insecurity on BMI and reduces the positive effect of food insecurity on psychological distress.

Conclusion

The findings from this study provide evidence of the long-lasting health effects of childhood food insecurity. Young adults who experienced food insecurity as children have higher psychological distress, even when adjusting for childhood socioeconomic status, parent's health, health during childhood, and food insecurity during adulthood. More severe and more frequent episodes of childhood food insecurity are related to worse psychological distress during adulthood, but even marginal food security and single episodes of food insecurity appear to be related to worse psychological distress during adulthood. Very low childhood food security also appears to be related to worse physical health during adulthood. The findings do not support the idea that childhood health is an important mediator, but rather that the intergenerational transmission of food insecurity may play a role in the relationship between childhood food insecurity and adult health. Finally, results suggest that SNAP participation during childhood may lower the negative effects of childhood food insecurity on adult health outcomes.

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Table 1: Baseline Descriptive Statistics

	Food secure CDS children below 250% of FPL in at least one wave between 1996 and 2002 (n=773)	Experienced food insecurity at least once between 1996 and 2002 (n=1312)
Child's time-invariant characteristics		
Female	0.517	0.495
Black ^a	0.469	0.558
Hispanic ^a	0.059	0.113
Other Race/Ethnicity	0.048	0.058
Circumstances at birth		
Low birth weight (<2500 grams)	0.109	0.111
Very low birth weight (<1500 grams)	0.017	0.019
Mother's age at birth	27.492	27.544
Birth paid by Medicaid ^a	0.315	0.520
Circumstances as child (birth to age 12)		
Child's age in 1997	6.822	7.131
Child covered by health insurance in 1996 ^a	0.891	0.768
Mother's health status fair/poor in 1996 ^a	0.094	0.191
Mother's years of completed education in 1996 ^a	12.263	11.536
Parents' married in 1996 ^a	0.600	0.508
Number of kids in household in 1996 ^a	2.194	2.507
Total Family Income in 1995 ^a	34750	26125
Head is working in 1995 ^a	0.817	0.697
Home is owned in 1996 ^a	0.536	0.395
Live in rural area in 1996 ^a	0.295	0.233
Average unemployment rate experienced between 1996-2002 ^a	4.768	4.861

Chi-square tests were used to test for significant differences in the means in all cases, except mother's age, child's age, total family income, and average unemployment rate where t-tests were used. FPL = federal poverty level.

^aSignificantly different means by food insecurity status at p<0.05.

Table 2: Descriptive Statistics on the Childhood Food Insecurity Experience of Sample (n=1312)

	Experienced food insecurity at least once between 1996 and 2002 (n=1312)
Average food security score (possible range 0.25-18)	2.042
Severity	
Experienced marginal food security only	0.402
Experienced low/very low food security at least once	0.598
Experienced very low food security at least once	0.189
Frequency	
Experienced food insecurity at only one wave	0.409
Experienced food insecurity at two waves	0.258
Experienced food insecurity at three waves	0.218
Experienced food insecurity at four waves	0.115
Frequency & Severity	
Experienced low/very low food security only once	0.301
Experienced low/very low food security multiple times	0.296
Experienced very low food security only once	0.130
Experienced very low food security multiple times	0.059
Timing	
Average food insecurity score between birth and age 5 (n=526)	2.018
Average food insecurity score between age 6 and age 12	2.043
Average food insecurity score between age 13 and age 18 (n=659)	1.976

Table 3: Baseline Descriptive Statistics by Severity and Frequency of Food Insecurity

	Experienced Marginal Food Security Only (n=528)	Experienced Low but Not Very Low Food Security (n=536)	Experienced Very Low Food Security (n=248)	Only one episode of food insecurity (n=537)	Multiple episodes of food insecurity (n=775)
Child's time-invariant characteristics					
Female	0.504	0.487	0.496	0.467	0.515
Black ^b	0.559	0.538	0.601	0.508	0.593
Hispanic ^b	0.093	0.123	0.133	0.088	0.130
Other Race	0.045	0.065	0.069	0.065	0.053
Circumstances at birth					
Low birth weight (<2500 grams)	0.116	0.103	0.117	0.104	0.115
Very low birth weight (<1500 grams)	0.019	0.019	0.020	0.024	0.015
Mother's age at birth	27.385	27.273	28.461	27.636	27.480
Birth paid by Medicaid ^{a,b}	0.470	0.523	0.617	0.415	0.592
Circumstances as child (birth to age 12)					
Child's age in 1997	6.963	7.241	7.250	7.326	6.996
Child covered by health insurance in 1996 ^{a,b}	0.806	0.740	0.750	0.822	0.731
Mother's health status fair/poor in 1996 ^{a,b}	0.088	0.242	0.298	0.112	0.245
Mother's years of completed education in 1996 ^{a,b}	11.891	11.428	11.013	12.081	11.153
Parents' married in 1996 ^{a,b}	0.557	0.521	0.379	0.598	0.446
Number of kids in household in 1996 ^{a,b}	2.303	2.606	2.725	2.378	2.596
Total Family Income in 1995 ^{a,b}	30544	24302	20658	33367	21108
Head is working in 1995 ^{a,b}	0.752	0.694	0.585	0.790	0.632
Home is owned in 1996 ^{a,b}	0.448	0.397	0.275	0.481	0.335
Live in rural area in 1996 ^{a,b}	0.225	0.265	0.181	0.223	0.240
Average unemployment rate experienced between 1996-2002 ^b	4.803	4.893	4.915	4.808	4.898

Chi-square tests were used to test for significant differences in the means in all cases, except mother's age, child's age, and total family income where t-tests were used. ^aSignificantly different means by severity at p<0.05. ^bSignificantly different means by frequency at p<0.05.

Table 4: Adult Health Outcomes and Health Care Utilization by Childhood Food Insecurity Status

	Food secure CDS children below 250% of FPL in at least one wave between 1996 and 2002 (n=773)	Experienced Marginal Food Security Only (n=528)	Experienced Low but Not Very Low Food Security (n=536)	Experienced Very Low Food Security (n=248)	Only one episode of food insecurity (n=537)	Multiple episodes of food insecurity (n=775)
Oldest age observed (range 18-31)	24.541	24.532	24.958	24.805	24.876	24.676
Self-reported health status (1=Excellent, 5=poor) ^a	2.301	2.286	2.403	2.512	2.337	2.404
BMI (range 15-60)	26.877	27.056	27.507	27.330	27.118	27.413
Number of chronic conditions (range 0-4)	0.300	0.288	0.308	0.379	0.277	0.338
K6 Score (range 0-24)	4.606	4.949	4.991	5.547	4.942	5.173
Psychological diagnosis ^a	0.166	0.150	0.144	0.222	0.140	0.175
Number of hospitalizations (range 0-10+) ^a	0.291	0.250	0.272	0.560	0.341	0.302

Chi-square tests were used to test for significant differences in the means in all cases except BMI where a t-test was used. FPL=federal poverty level.

^aSignificantly different means by severity at $p < 0.05$. ^bSignificantly different means by frequency at $p < 0.05$.

Table 5: Childhood health, Adult Food Insecurity, & Childhood SNAP participation by Childhood Food Insecurity Status

	Food secure CDS children below 250% of FPL in at least one wave between 1996 and 2002 (n=773)	Experienced Marginal Food Security Only	Experienced Low but Not Very Low Food Security	Experienced Very Low Food Security	Only one episode of food insecurity	Multiple episodes of food insecurity
Child rated in Fair/Poor Health in 97/02/07 ^{a,b}	0.041	0.059	0.085	0.149	0.066	0.098
Child overweight (pBMI>0.85) in 97/02/07	0.394	0.400	0.419	0.415	0.425	0.401
Child obese (pBMI>=0.95) in 97/02/07	0.236	0.233	0.274	0.241	0.258	0.246
Child has emotional problem in 97/02/07 ^{a,b}	0.226	0.193	0.254	0.370	0.218	0.276
Child has asthma in 97/02/07	0.190	0.210	0.198	0.198	0.212	0.196
Food insecure in 2014 (as an adult) ^{a,b}	0.280	0.424	0.523	0.622	0.415	0.561
In Poverty in 2014 (as an adult) ^{a,b}	0.151	0.214	0.279	0.343	0.176	0.326
Received SNAP at least 1 month between 1996-2002 ^{a,b}	0.279	0.436	0.616	0.762	0.410	0.683
Number of months received SNAP between 1996-2002 ^{a,b}	8.082	14.420	22.078	29.319	12.280	25.966

Chi-square tests were used to test for significant differences in the means. FPL=federal poverty level. ^aSignificantly different means by severity at p<0.05.

^bSignificantly different means by frequency at p<0.05.

Table 6: Relationship between Childhood Food Insecurity Severity & Adult Health Outcomes

Regression Model	(1) Ordered Logit	(2) OLS	(3) Ordered Logit	(4) Ordered Logit	(5) Logit	(6) Ordered logit
	Adult Health Status (1=Excellent, 5=Poor)	Adult BMI (range 15- 60)	Number of chronic conditions in adulthood (range 0-3)	Adult Psychological Distress (K6) Score (range 0-24)	Mental health diagnosis (reported as adult)	Number of days hospitalized in last year (adult)
Average Food Insecurity Score during childhood	0.017 (0.028)	-0.011 (0.088)	0.048 (0.030)	0.082*** (0.024)	0.082** (0.038)	0.071* (0.043)
Observations	1,900	1,892	1,900	1,894	1,900	1,900
Any Food Insecurity as child	0.081 (0.092)	0.183 (0.332)	0.060 (0.116)	0.296*** (0.092)	0.106 (0.144)	0.173 (0.185)
Observations	1,900	1,892	1,900	1,894	1,900	1,900
Experienced Marginal Food Security Only as child	-0.030 (0.109)	0.209 (0.394)	-0.042 (0.136)	0.233** (0.108)	0.036 (0.177)	-0.031 (0.227)
Experienced Low/Very Low Food Security as child	0.176* (0.106)	0.161 (0.390)	0.143 (0.136)	0.351*** (0.108)	0.164 (0.163)	0.324 (0.207)
Observations	1,900	1,892	1,900	1,894	1,900	1,900
Experienced Marginal/Low but Not Very Low Food Security as child	0.064 (0.093)	0.222 (0.337)	0.006 (0.121)	0.257*** (0.094)	0.010 (0.153)	0.035 (0.194)
Experienced Very Low Food Security as child	0.185 (0.179)	-0.039 (0.611)	0.344* (0.181)	0.530*** (0.162)	0.606*** (0.225)	0.745*** (0.270)
Observations	1,900	1,892	1,900	1,894	1,900	1,900

Coefficients reported. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Controls included child's birthweight, child's health insurance coverage, child's age, child's gender, child's race/ethnicity, parents' health, parents' age, parents' education, parents' marital status, household composition, total family income, parents' employment status, home ownership, rural residence, and the average annual state unemployment rate experienced by the household between 1996-2002.

Table 7: Relationship between Childhood Food Insecurity Severity and Frequency & Adult Health Outcomes

Regression Model	(1) Ordered Logit	(2) OLS	(3) Ordered Logit	(4) Ordered Logit	(5) Logit	(6) Ordered logit
	Adult Health Status (1=Excellent, 5=Poor)	Adult BMI (range 15- 60)	Number of chronic conditions in adulthood (range 0-3)	Adult Psychological Distress (K6) Score (range 0-24)	Mental health diagnosis (reported as adult)	Number of days hospitalized in last year (adult)
One episode of childhood food insecurity (Ref=no episodes)	0.077 (0.106)	0.219 (0.391)	-0.069 (0.141)	0.261** (0.107)	-0.130 (0.182)	0.150 (0.223)
Multiple episodes of childhood food insecurity	0.085 (0.111)	0.150 (0.401)	0.175 (0.134)	0.331*** (0.112)	0.327** (0.164)	0.194 (0.203)
Observations	1,900	1,892	1,900	1,894	1,900	1,900
Experienced Marginal Food Security only as child (Ref=no episodes)	-0.032 (0.109)	0.207 (0.394)	-0.041 (0.136)	0.236** (0.108)	0.038 (0.177)	-0.033 (0.227)
One episode of Low/Very Low Food Security as child	0.223* (0.122)	0.229 (0.443)	0.116 (0.166)	0.249** (0.124)	0.004 (0.197)	0.426* (0.238)
Multiple episodes of Low/Very Low Food Security as child	0.119 (0.135)	0.078 (0.487)	0.175 (0.161)	0.476*** (0.134)	0.355* (0.197)	0.199 (0.255)
Observations	1,900	1,892	1,900	1,894	1,900	1,900
Experienced Marginal/Low but Not Very Low Food Security as child (Ref=no episodes)	0.064 (0.093)	0.222 (0.337)	0.008 (0.121)	0.257*** (0.094)	0.008 (0.153)	0.034 (0.194)
One episode of Very Low Food Security as child	0.200 (0.186)	-0.084 (0.733)	0.232 (0.203)	0.560*** (0.175)	0.686*** (0.238)	0.815*** (0.294)
Multiple episodes of Very Low Food Security as child	0.147 (0.355)	0.072 (0.840)	0.603* (0.311)	0.461 (0.283)	0.373 (0.441)	0.544 (0.452)
Observations	1,900	1,892	1,900	1,894	1,900	1,900

Coefficients reported. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Controls included child's birthweight, child's health insurance coverage, child's age, child's gender, child's race/ethnicity, parents' health, parents' age, parents' education, parents' marital status, household composition, total family income, parents' employment status, home ownership, rural residence, and the average annual state unemployment rate experienced by the household between 1996-2002.

Table 8: Relationship between the Timing of Childhood Food Insecurity & Adult Health Outcomes

Regression Model	(1) Ordered Logit	(2) OLS	(3) Ordered Logit	(4) Ordered Logit	(5) Logit	(6) Ordered logit
	Adult Health Status (1=Excellent, 5=Poor)	Adult BMI (range 15- 60)	Number of chronic conditions in adulthood (range 0-3)	Adult Psychological Distress (K6) Score (range 0-24)	Mental health diagnosis (reported as adult)	Number of days hospitalized in last year (adult)
Average Food Security Score between birth and age 5	0.025 (0.032)	-0.190* (0.099)	-0.054 (0.040)	0.024 (0.029)	0.073 (0.049)	0.059 (0.071)
Average Food Security Score between age 6-12	0.003 (0.028)	0.093 (0.086)	0.050* (0.027)	0.052** (0.024)	0.008 (0.034)	0.013 (0.042)
Average Food Security Score between age 13-18	0.003 (0.028)	0.017 (0.103)	0.016 (0.031)	0.048* (0.029)	0.087** (0.039)	0.057 (0.054)
Observations	1,900	1,892	1,900	1,894	1,900	1,900
Average Food Security Score between birth and age 5	-0.007 (0.037)	-0.256** (0.116)	-0.073 (0.047)	0.021 (0.036)	0.010 (0.059)	0.051 (0.070)
Average Food Security Score between age 6-12	0.058 (0.040)	0.213* (0.123)	0.034 (0.047)	0.059* (0.036)	0.100* (0.052)	-0.055 (0.081)
Observations	777	772	777	774	777	777
Average Food Security Score between age 6-12	-0.027 (0.043)	0.032 (0.134)	0.013 (0.009)	0.063* (0.037)	-0.004 (0.050)	0.043 (0.052)
Average Food Security Score between age 13-18	0.021 (0.031)	0.070 (0.113)	0.008 (0.008)	0.033 (0.034)	0.102** (0.045)	0.042 (0.059)
Observations	876	875	876	874	876	876

Coefficients reported. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Controls included child's birthweight, child's health insurance coverage, child's age, child's gender, child's race/ethnicity, parents' health, parents' age, parents' education, parents' marital status, household composition, total family income, parents' employment status, home ownership, rural residence, and the average annual state unemployment rate experienced by the household between 1996-2002.

Table 9: Is the relationship between the Childhood Food Insecurity & Adult Health Outcomes mediated by Childhood Health?

Regression Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Ordered Logit		OLS		Ordered Logit		Ordered Logit		Logit		Ordered logit	
	Adult Health Status (1=Excellent, 5=Poor)		Adult BMI (range 15-60)		Number of chronic conditions in adulthood (range 0-3)		Adult Psychological Distress (K6) Score (range 0-24)		Mental health diagnosis (reported as adult)		Number of days hospitalized in last year (adult)	
Average Food Insecurity Score during childhood	0.019 (0.031)	0.015 (0.031)	-0.008 (0.097)	0.073 (0.071)	0.046 (0.032)	0.057* (0.034)	0.078*** (0.025)	0.069*** (0.026)	0.058 (0.039)	0.014 (0.041)	0.029 (0.047)	0.015 (0.049)
PCG rated child as having fair/poor health as a child		0.310 (0.194)		-0.136 (0.473)		0.474** (0.233)		0.188 (0.231)		0.642** (0.278)		0.333 (0.347)
Overweight (pBMI>85%) as a child		0.417*** (0.127)		4.383*** (0.349)		0.253 (0.169)		0.092 (0.131)		0.359* (0.207)		0.341 (0.230)
Obese (pBMI>95%) as a child		0.415*** (0.140)		4.772*** (0.461)		0.343* (0.185)		-0.010 (0.149)		0.119 (0.231)		-0.237 (0.287)
Had an emotional problem as a child		0.164 (0.112)		0.114 (0.291)		0.196 (0.149)		0.265** (0.116)		1.383** *		0.621** *
Had asthma as a child		0.039 (0.113)		0.175 (0.332)		2.645*** (0.152)		0.124 (0.115)		0.062 (0.196)		-0.019 (0.241)
Observations	1,628	1,628	1,621	1,621	1,628	1,628	1,622	1,622	1,628	1,628	1,628	1,628

Coefficients reported. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Controls not shown included child's birthweight, child's health insurance coverage, child's age, child's gender, child's race/ethnicity, parents' health, parents' age, parents' education, parents' marital status, household composition, total family income, parents' employment status, home ownership, rural residence, and the average annual state unemployment rate experienced by the household between 1996-2002.

Table 10: Is the relationship between the Childhood Food Insecurity & Adult Health Outcomes mediated by Adult Food Insecurity?

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Regression Model	Ordered Logit		OLS		Ordered Logit		Ordered Logit		Logit		Ordered logit	
	Adult Health Status (1=Excellent, 5=Poor)		Adult BMI (range 15-60)		Number of chronic conditions in adulthood (range 0- 3)		Adult Psychological Distress (K6) Score (range 0-24)		Mental health diagnosis (reported as adult)		Number of days hospitalized in last year (adult)	
Average Food Insecurity Score during childhood	0.020 (0.029)	0.002 (0.029)	-0.006 (0.091)	-0.019 (0.094)	0.047 (0.031)	0.028 (0.031)	0.083*** (0.024)	0.050** (0.025)	0.075** (0.038)	0.040 (0.039)	0.072 (0.045)	0.030 (0.046)
Food insecure in 2014 (as an adult)		0.371*** (0.096)		0.408 (0.361)		0.357*** (0.118)		0.641*** (0.091)		0.579*** (0.139)		0.806*** (0.189)
In Poverty in 2014 (as an adult)		0.046 (0.123)		-0.305 (0.416)		0.111 (0.131)		0.126 (0.116)		0.540*** (0.174)		0.513** (0.204)
Observations	1,770	1,770	1,762	1,762	1,770	1,770	1,764	1,764	1,770	1,770	1,770	1,770

Coefficients reported. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Controls not shown included child's birthweight, child's health insurance coverage, child's age, child's gender, child's race/ethnicity, parents' health, parents' age, parents' education, parents' marital status, household composition, total family income, parents' employment status, home ownership, rural residence, and the average annual state unemployment rate experienced by the household between 1996-2002.

Table 11: Relationship between SNAP participation during childhood & Adult Health

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Adult Health Status (1=Excellent, 5=Poor)		Adult BMI (range 15-60)		Number of chronic conditions in adulthood (range 0-3)		Adult Psychological Distress (K6) Score (range 0-24)		Mental health diagnosis (reported as adult)		Number of days hospitalized in last year (adult)	
Received SNAP at least 1 month between 1996-2002	-0.498 (0.475)		6.625** (3.306)		-0.165 (0.256)		-3.511 (2.184)		-0.140 (0.199)		-1.038 (0.654)	
Log(number of months received SNAP between 1996-2002)		-0.267 (0.194)		2.638* (1.443)		-0.052 (0.100)		-1.316 (0.898)		-0.059 (0.079)		-0.423 (0.259)
Average Food Insecurity Score during childhood	0.034 (0.024)	0.048 (0.029)	-0.292* (0.167)	-0.361* (0.219)	0.018 (0.014)	0.018 (0.016)	0.340*** (0.111)	0.364*** (0.134)	0.017* (0.010)	0.019 (0.012)	0.059* (0.033)	0.071* (0.040)
Observations	1,900	1,900	1,892	1,892	1,900	1,900	1,894	1,894	1,900	1,900	1,900	1,900

Coefficients reported from linear two-state least square models. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Instruments for both SNAP participation variables include the household exposure between 1996 and 2002 to the following state- and time-varying SNAP program rules: full immigrant eligibility, partial immigrant eligibility, simplified reporting of changes, and vehicle exclusions from asset tests.

Controls not shown included child's birthweight, child's health insurance coverage, child's age, child's gender, child's race/ethnicity, parents' health, parents' age, parents' education, parents' marital status, household composition, total family income, parents' employment status, home ownership, rural residence, and the average annual state unemployment rate experienced by the household between 1996-2002.

Appendix Table 1: First stage results for instrumental variable regressions

	Received SNAP at least 1 month between 1996-2002	Logarithm of the number of months received SNAP between 1996-2002
All non-citizen adults are eligible for SNAP ^a	-0.006*** (0.002)	-0.017** (0.007)
Some non-citizen adults are eligible for SNAP ^b	-0.005** (0.002)	-0.014** (0.007)
Simplified Reporting ^c	-0.005*** (0.002)	-0.011** (0.005)
Some vehicles are excluded from SNAP asset test ^d	0.002** (0.001)	0.004** (0.002)
Average food security score as child	-0.000 (0.006)	0.003 (0.019)
Age at latest PSID interview	0.041*** (0.006)	0.128*** (0.022)
Female	0.010 (0.018)	0.042 (0.059)
Black	0.043 (0.031)	0.177* (0.092)
Hispanic	0.046 (0.054)	-0.032 (0.159)
Other race/ethnicity	0.050 (0.060)	0.107 (0.188)
Low birth weight (<2500 grams)	0.031 (0.037)	0.054 (0.120)
Very low birth weight (<1500 grams)	0.072 (0.077)	0.231 (0.251)
Mother's age at birth	-0.002 (0.002)	-0.004 (0.006)
Birth paid by Medicaid	0.187*** (0.026)	0.652*** (0.086)
Child's age in 1996	-0.008 (0.006)	-0.038** (0.018)
Child covered by health insurance in 1996	-0.013 (0.033)	0.142 (0.104)
Mother's health status fair/poor in 1995	0.038 (0.033)	0.135 (0.112)
Mother's years of completed education	-0.013** (0.005)	-0.067*** (0.018)
Parents' married in 1995	-0.111*** (0.032)	-0.329*** (0.102)
Number of kids in household in 1995	0.046*** (0.010)	0.182*** (0.035)
Total Family Income in 1995	-0.053*** (0.020)	-0.204*** (0.065)
Head is working in 1995	-0.196***	-0.942***

	(0.034)	(0.119)
Home is owned in 1995	-0.079***	-0.205**
	(0.028)	(0.089)
Live in rural area in 1995	0.044	-0.014
	(0.029)	(0.091)
Average unemployment rate experienced between 1996-2002	0.048***	0.121**
	(0.015)	(0.048)
Constant	1.403***	4.953***
	(0.299)	(0.984)
Observations	1,900	1,900
R-squared	0.387	0.456
F-test	56.01	64.18

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

^a% months between 1996-2002 where household's state granted SNAP eligibility to all legal noncitizen adults (age 18-64) who satisfy other SNAP eligibility requirements (mean=22.4% SD=19.4%)

^b% months between 1996-2002 where household's state granted SNAP eligibility to some, but not all, legal noncitizen adults (age 18-64) who satisfy other SNAP eligibility requirements (mean=58.2% SD=18.8%)

^c% months between 1996-2002 where household's state uses the simplified reporting option for households with earnings to reduce requirements for reporting changes in household circumstances (mean=5.7% SD=8.4%)

^d% months between 1996-2002 where household's state excluded some of the value of at least one vehicle from SNAP asset tests (mean=18.4% SD=20.1%)