Does Childhood Access to SNAP Lead to Better Adult Mental Health? Evidence from PSID

Lingxiao Wang, University of Wisconsin – Madison, lingxiao.wang@wisc.edu
Haoyuan Xia, University of Wisconsin – Madison, hxia35@wisc.edu
Steven Buck, University of Kentucky, steven.buck@uky.edu

Selected Paper prepared for presentation at the 2023 Agricultural & Applied Economics Association Annual Meeting, Washington DC; July 23-25, 2023

Abstract

We investigate the impacts of childhood access to the Supplemental Nutrition Assistance Program (SNAP) on adult mental health illnesses. Leveraging a unique trait of the Panel Study of Income Dynamics (PSID), which surveys both parents and offspring, we assemble individual data linking childhood and adulthood households. Given SNAP participation is determined by household income thresholds related to the 130% Federal Poverty Line, we explore a Regression Discontinuity design and estimate the causal impact of childhood SNAP participation. Our findings reveal that childhood SNAP participation leads to a significant 3.9-percentage point reduction in instances of mental health disorders in adulthood, with notable decreases observed in depression, mania, and obsessive-compulsive disorder. The effect is most pronounced when individuals participate in SNAP before the age of six. However, we find no significant benefits of adult SNAP participation on adult mental health. Additionally, childhood SNAP participants tend to become aware of their instances of mental health disorders earlier than non-participants, potentially enabling participants to develop strategies to promote their mental health from an earlier age.

Keywords: Food Assistance Program, Mental Health, Long-run Effects

JEL: I12, I38, J24

1. Introduction

One in four adults in the U.S. suffers from a diagnosed mental health disorder (National Institutes of Health, 2022). The number of mental health disorders for the low-income population is 20% larger. Untreated mental illness reduces productivity costing over $300 billion every year, and certain types of mental illness, such as depression and psychosis, may even induce suicide (National Institutes of Health, 2015). However, most lifetime mental illnesses take root in early-life stages. Half of mental illnesses start in childhood before the age of 14, with 75% of the illnesses beginning by age 24 (National Alliance on Mental Health, 2022). Researchers find that childhood life experiences, such as the adversity of experiencing food insecurity, hunger, and malnutrition, are highly related to mental development later in life (Huang, et al., 2013, McIntyre, et al., 2013). Therefore, if members of the low-income population receive food assistance at younger ages, it is possible that their mental health may improve in adulthood. In this study, we examine the long-term effects of the Supplemental Nutrition Assistance Program (SNAP) on mental health outcomes using the Panel Study of Income Dynamics (PSID) data from 1968 to 2019.

As the largest nutrition assistance program in the US, SNAP substantially reduces the prevalence of food insecurity, which is critical to reducing negative health outcomes (Gundersen and Ziliak, 2015). Hoynes, et al. (2016) examined that access to SNAP in early childhood improved people's metabolic syndrome in their later lives. While most studies find significant results on SNAP improving physical health, evidence of whether SNAP benefits mental health is mixed. Some studies find that participating in SNAP is helpful in relieving psychological distress (Oddo and Mabli, 2015). However, others find that children in SNAP families are more likely to face mental health problems than those in non-SNAP families (Melo, et al., 2023). Although the evidence does not mean that participating in SNAP brings negative effects on mental health. The greater number of mental health disorders in SNAP families could be attributed to the selection bias that individuals with mental problems are more vulnerable to food security and thus more likely to be selected into SNAP (Adynski, et al., 2020, Heflin and Ziliak, 2008). As a result, the association between participating in SNAP and current mental health status may end up both ways without a causal intent.

We take advantage of two special characteristics of PSID to draw causal conclusions on the long-term impacts of SNAP on mental health. On the one hand, we are able to connect children's households with parental households so as to obtain information from both the individual's childhood and adulthood. As America's Family Tree[1], PSID has been surveying households through a genealogic approach since 1968. Thus, in this research, we are able to retrieve variables, such as SNAP participation, household income and property, and other demographics, from individual's parental families where individuals were first exposed to SNAP in their lifetimes. Since PSID is the longest-running longitudinal household survey in the world, the SNAP participation data can be dated back to 1968, when households in PSID were first interviewed. The over fifty-year study window, from 1968 to 2019, allows us to observe the long-term effects of SNAP on mental health.

We employ a fuzzy regression discontinuity (RD) design to estimate the causal impact of participating in SNAP in childhood on adult mental health. RD is used in many program evaluations when enrollment in the program has a cut-off threshold that determines eligibility. For example, previous studies use an age cut-off of 65 years to compare the impacts of participating in Medicare on the elder population's health (Card, et al., 2008). Instead of a sharp discontinuity, for SNAP enrollment, there is a fuzzy income cut-off

[1] "When family members split-off and create their own separate family units, the PSID interviews these new family units as well as the original family units." (PSID Family Identification Mapping System User Manual. Institute for Social Research, University of Michigan, March 2021.)

set by the federal government[2]: household gross monthly income generally must be at or below 130% of the poverty line (FPL). The eligibility of 130% FPL for SNAP enrollment implies that household applicants with gross income below 130% Federal Poverty Line have a larger probability to enroll in the SNAP program. This fuzzy income cut-off has been applied in two recent pieces of literature. Gundersen, et al. (2017) used the cut-off to identify the causal impacts of participating in SNAP on food insecurity, and Booshehri and Dugan (2021) used it to explore the impact of SNAP on diet-related disease morbidity among older adults.

We follow the two prior studies by employing the 130% FPL as an instrument for participation in SNAP of parental households and estimating the causal impact of early-life access to SNAP on adult mental health. We find a robust result that childhood participation in SNAP leads to a 3.9-percentage point decrease for mental health disorders in adulthood, given the mean of adulthood mental health disorder rate is 6.9%. The effects are contributed by the decline in depression, mania and obsessive-compulsive disorder (OCD) in adulthood. In addition, we confirm with previous studies that SNAP participation at an early age (before the age of six) has the most benefit, which brings more significant impact on reducing adulthood mental health disorders. However, the estimate for childhood SNAP participants who participate in SNAP again during adulthood is positive, though not significant, implying that adulthood participation in SNAP may not help with adult meatal health. Furthermore, we also find that SNAP participants notice their mental health disorders at an earlier time than those who did not participate. Besides the nutrition stimulus of SNAP, it is possible that individuals who participate in SNAP during childhood are aware of their mental health disorders earlier than non-participants and gradually learn how to better live with mental health disorders and to combat later-life adversity and mental fluctuation.

The study contributes most directly to the literature examining low-income households, especially in applying the causal inference method to the intergenerational study. We are creative to apply RD in intergenerational studies. Previous studies either use a fixed-effect model to study the long-term effects of SNAP or apply RD to study the short-term effects of SNAP. To our knowledge, we are the first to apply the regression discontinuity to the long-term effects of SNAP and the first to analyze the impacts of early-life access to SNAP on adult mental health. Childhood access to SNAP is usually determined by parental enrollment in SNAP. By connecting child households with parent households in PSID, we are able to obtain the income and SNAP participation status of parental households which allows us to identify the childhood access to SNAP of individuals. These findings provide valuable insight for policymakers and practitioners in designing interventions that support mental health in low-income households.

2. Literature Review

SNAP can influence mental health through improving food security and diet nutrition. It is widely acknowledged that low food insecurity is correlated with depression and other mental health problems (Fang, et al., 2021, Leung, et al., 2015). Given the role of SNAP in combating food insecurity among the low-income population (Gundersen, et al., 2011, Mabli and Ohls, 2015), it is suggested that the program may improve mental health outcomes by increasing food security. Moreover, recent research has found that SNAP can provide adequate nutrition to the low-income households (Andreyeva, et al., 2015, Bitler, et al., 2015, Carlson and Keith-Jennings, 2018). This nutrition effect has the potential to indirectly impact mental health as well. In addition to food security and nutrition effects, SNAP can also affect mental health through

[2] The federal government set three eligibility requirements for households to qualify for SNAP benefits. Firstly, the household's gross monthly income must not exceed 130% FPL. Secondly, the household's net income must remain at or above the FPL. Finally, the household's assets must not exceed $2,750 if no member is elderly or disables, or $4,250 if such a member exists.

an income effect. By expanding the household budgets for recipients, SNAP may alleviate the financial strain, freeing up extra funds that can be used to ameliorate well-being (Gregory and Deb, 2015).

It seems that participating in SNAP can improve mental health based on the rationale above, but the empirical results are mixed. Some articles find that participating SNAP is beneficial to mental health (Oddo and Mabli, 2015), while others do not find significant effects (Adynski, et al., 2020, Heflin and Ziliak, 2008). There are three main reasons for the mixed results regarding the impact of SNAP on mental health. First, most studies cannot eliminate the threat of reciprocal causation between current SNAP participation and current mental health (Bartfeld, et al., 2015). People with mental health disorders are more likely to participate in SNAP and get food assistance (Adynski, et al., 2020). It is hard to find a causal relationship between SNAP and mental health without addressing the selection bias of participating in SNAP, and most studies that find significant results merely argue causality. Second, there are also possible negative effects of participating in SNAP on mental health (Heflin and Ziliak, 2008), such as stigma (Pak and Kim, 2020) and negative perception of welfare (Bergmans, et al., 2018). Third, most studies study the short-term effects of SNAP, how current participation in SNAP affects current mental health status; however, it takes time to convert food sufficiency into effects reflected on mental health. SNAP directly affects household food purchases and food security, and then indirectly affects individual mental health. The entire process can take years. It is reasonable to find insignificant effects in the short run but long-term considerable effects (Aizer, et al., 2022). To our knowledge, we are the first to research the long-term impact of early-life access to SNAP on later-life mental health.

Some research investigates the impacts of early-life access to SNAP on other adulthood outcomes than mental health. One study by Hoynes, et al. (2016) has revealed that that early-life access to SNAP significantly improves adulthood physical health, particularly among female recipients. Through an examination of the rollout of SNAP in the 1960s, these researchers pin down the causal effects of how a county adopting SNAP affect the subsequent economic self-sufficiency and health outcomes in later life. Their study has focused on metabolic syndromes including diabetes, high blood pressure, obesity, heart disease and heart attack. Other researchers echo the constructive impacts of SNAP on physical health, but most of them focus on the short-term effects of gaining access to SNAP (Alfaro-Hudak, et al., 2022). But there is no research studying the impact of early-life access to SNAP on adult mental health.

One of the crucial challenges in identifying the causal impacts of participating SNAP is to overcome the selection bias (Bartfeld, et al., 2015). Since SNAP is not randomly assigned to the population, households with poor health outcomes and severe food security status are more inclined to apply for SNAP (de Cuba, et al., 2019). Consequently, standard statistical methods such as OLS estimation or fixed-effect estimation, which do not adequately account for time-variant unobserved variables, yield biased estimates that tend towards zero. To mitigate the selection bias, (Hoynes, et al., 2016, Hoynes and Schanzenbach, 2009) have utilized the rollout of SNAP adoption across counties during the 1960s as a quasi-experiment and applied Difference-in-Differences method to estimate the long-term effects of such adoption. The SNAP adoption rollout was implemented from 1961 to 1975, resulting in a research sample that primarily focuses on Baby Boomers (born circa 1946 to1964) and Generation X (born circa 1965 to 1980). However, it remains unclear whether similar outcomes would also manifest among the Millennial Generation (born circa 1981 to 1996) and Gen Z (born circa 1997 to 2012).

More recently, increasing researchers have explored the RD methodology to obtain causality of SNAP participation. By comparing very similar households around the 130% FPL SNAP eligibility cut-off, we can obtain causal inference of participating in SNAP, assuming that households whose household gross income are just above and just below 130% FPL share similar unobserved household characteristics. Although the 130% FPL is not a sharp cut-off (Hoynes and Schanzenbach, 2015), households whose gross

income below the 130% FPL have larger chances to pass the SNAP income-eligibility test (Alfaro-Hudak, et al., 2022), providing the sufficiency for a fuzzy RD. To strengthen the instrument, a few studies with more informative data further refine the cut-off of income-eligibility criteria by considering the categorical SNAP eligibility (Booshehri and Dugan, 2021) since SNAP expansion in 2000 (Han, 2020, Olds, 2016) and the detailed SNAP eligibility requirements in asset and net income (Gundersen, et al., 2017). However, all the studies using Fuzzy RD focus on the short-term effects of SNAP, none of them investigate long-term effects of SNAP.

Inspired by both strains of method, we explore a fuzzy RD to examine the long-term impact of participating in SNAP in childhood on adult mental health. Our study differs from previous studies on the long-run effects of childhood SNAP participation, as it does not rely on the rollout of SNAP adoption, thereby enabling us to explore these effects on individuals across multiple generations.

3. Data

Our household and individual data is obtained via PSID. As the longest longitudinal survey data in the world, PSID contains about 5,000 households over the first survey in 1968. It continually surveys these households and enlarges the sample by including the households of their offspring in the following waves of survey. In other words, it is possible to retrieve family trees of households in PSID. Since 1999, PSID has surveyed every two years, but before that it surveyed their participants every year. They name each survey period as a survey wave. In the 2019 wave, there are 9,569 households in PSID. The characteristic of the data empowers us to connect individual's households with their parental households and to obtain extensive information from both childhood and adulthood.

We select our individual sample in the following ways. First, we select individuals who are offspring of PSID households, who have formed new households after entering adulthood, and who stay in PSID in the following waves from 1968 to 2019. As such, we drop individuals who are older than 18 when they enter PSID (possibly parents/grandparents). Additionally, we only keep individuals who have mental health information. PSID has started to collect mental health information since 1999. In this case, we dropped individuals who passed away before 1999. Moreover, we exclude individuals who have missing records on childhood SNAP participation status, childhood family income, or adulthood mental health condition. Furthermore, in our main result setting, we only include individuals who participate in SNAP only during their childhood, which means we exclude adulthood SNAP participants and childhood SNAP participants that participate SNAP again in adulthood.

Based on the individual sample, we matched individual information with childhood households and adulthood households according to individual id, interview year and family id. Therefore, the merged dataset contains individual level information, and household-level information of the sampled individuals for both childhood and adulthood households. Overall, there are 5,199 individuals remaining in the sample. 2,275 individuals are exposed to SNAP during their childhood (before the age of eighteen). For these childhood SNAP recipients, 20.79% of them first get access to SNAP from age zero to age 1, 56.66% of them get access to SNAP from age zero to age six, 81.32% of them are exposed to SNAP before age 12.

The distribution of the gross income in the nominal term for childhood households is shown in Figure 1. Together, we highlight the FPL and the RD cut-off of 130% FPL for SNAP gross income eligibility. As the FPL is adjusted annually for inflation, the cut-off of 130%FPL also changes across years. The gross income distribution has a heavy left tail and thin right tail, which indicates that there are more low-income

households included in the PSID sample. However, around the cut-off, the distribution tends to be smooth without apparent bunching.

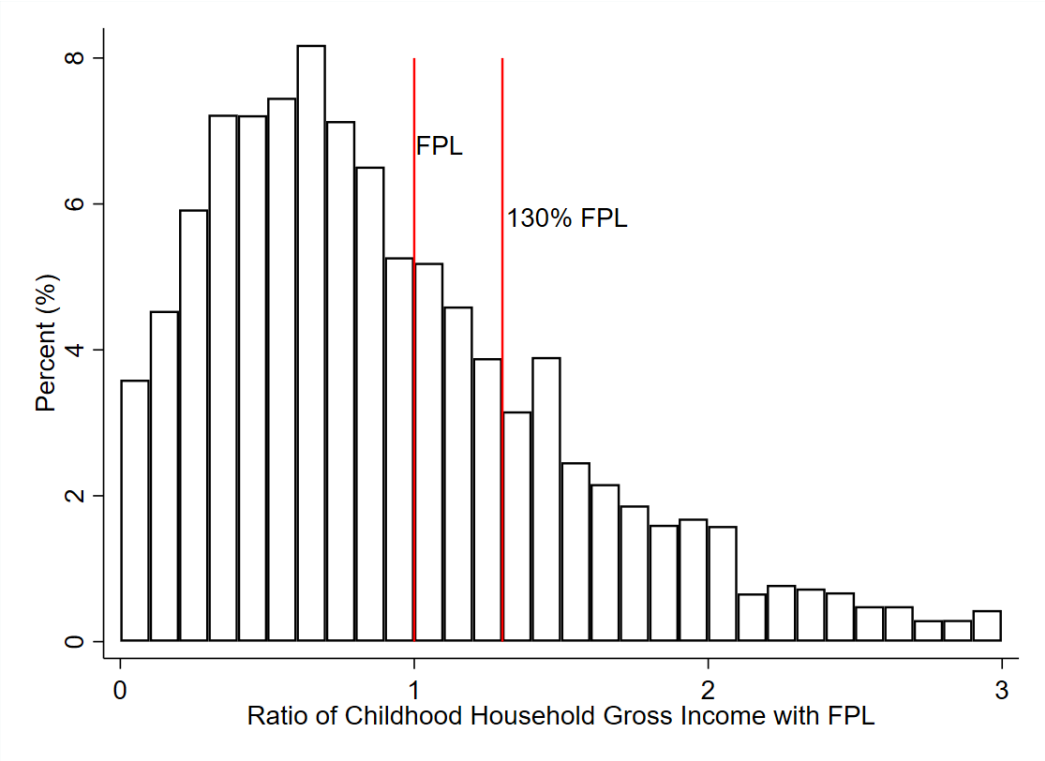

Figure 1. Distribution of Childhood Household Gross Income

The mental health variable, $mental\_ill$ is also sourced from PSID, Wave 1999-Wave 2019, based on the question "Has a doctor ever told you that you have or had any emotional, nervous, or psychiatric problems?". The variable indicates whether the individual is diagnosed with mental health disorders. If individuals are diagnosed with mental health disorders by a doctor, the variable is assigned 1; if individuals are not diagnosed with mental health disorders by a doctor, the variable is assigned 0. From 2009 to 2019, the rate for diagnosed mental health disorders hike from 4.67% to 12%. Furthermore, we also construct the type of individual's mental health disorder according to the eight categories given by PSID: depression (32.67%), bipolar disorder (mania, 6.44%), schizophrenia (0.27%), anxiety (40.61%), alcohol and drug abuse (0.42%), obsessive-compulsive disorder (OCD, 2.35%), and other health problems including Post-Traumatic Stress Disorder (PTSD) and phobias (16.79%). We did not observe any discernible disparities in rates of diagnosed mental health disorders in adulthood between those who received SNAP benefits during their childhood and those who did not receive such support (Table 1). It is noteworthy that individuals who received SNAP benefits during their childhood exhibited higher rates of depression and drug and alcohol use during that period. However, as these individuals reached adulthood, the disparity in rates between those who did and did not receive SNAP became less pronounced. Nonetheless, individuals who participated in SNAP during their childhood have higher rates of schizophrenia, and other mental health disorders including PTSD and phobias in their adulthood.

Table 1. Summary Statistics for Individual Adulthood

Variables	Childhood Non-SNAP	Childhood SNAP	Mean Diff

Mental Health Disorder			
Mental Health Disorder	0.069	0.054	0.014***
Age First Diagnosing Mental Illness	27.212	24.955	2.257***
Depression	0.022	0.014	0.008**
Mania	0.003	0.004	-0.001
Schizophrenia	0.000	0.001	-0.001***
Anxiety	0.017	0.013	0.004***
Alcohol & Drug Abuse	0.000	0.000	0.000
OCD	0.001	0.001	-0.000
PTSD, Phobias & Other	0.002	0.003	-0.001*
Other Variables			
Age	34.323	29.844	4.481***
Married	0.698	0.582	0.117***
Height(m)	1.726	1.719	0.006***
Weight(kg)	80.152	82.091	-1.940***
Educations Years	11.007	9.653	1.354***
Smoking	0.129	0.181	-0.052***
Drinking	0.736	0.654	0.082***
Stroke	0.010	0.007	0.003***
High Blood Pressure	0.179	0.159	0.021***
Diabetes	0.053	0.045	0.008***
Cancer	0.038	0.029	0.009***
Repository Diseases	0.021	0.020	0.001
Heat Attack	0.012	0.009	0.003**
Heart Diseases	0.019	0.014	0.005***
Arthritis	0.090	0.064	0.026***
Asthma	0.080	0.094	-0.014***
Mental Loss	0.004	0.007	-0.003***
Learn Disability	0.022	0.017	0.005***
Light Activities (hrs/week)	4.446	4.390	0.056
Heave Activities (hrs/week)	2.712	2.793	-0.082
Moderate Activities (hrs/week)	1.406	1.545	-0.139***

The study incorporates additional variables pertaining to both childhood and adulthood. Table 2 compares the descriptive statistics of childhood variables between individuals who received access to SNAP during their childhood and those who did not. Notably, the former group comprises individuals from more deprived demographics and parental households and exhibits higher rates of depression and other psychological problems. However, this trend does not hold for childhood physical health. In fact, individuals who received SNAP during childhood had fewer health issues such as hearing problems, measles, mumps, chickenpox, and respiratory diseases during their childhood. In addition, we also control adulthood variables including individual age, gender, race, education, marital status, BMI, physical diseases, risky behaviors (smoking and drinking) and the amount of exercise. The demographic variables in adulthood are shown in Table 1.

Table 2. Summary Statistics for Individual Childhood

Variables	Childhood Non-SNAP	Childhood SNAP	Mean Diff
Childhood Demographics			
Female	0.523	0.502	0.021
Black	0.122	0.376	-0.254***
White	0.830	0.575	0.255***
Hispanic	0.068	0.069	-0.001
Childhood Households			
Income	39971.66	14206.43	25765.23***
Siblings	0.767	0.781	-0.014***
Head Education (years)	17.049	16.026	1.023***
Head Married	0.779	0.557	0.222***
Sibling Numbers	1.503	2.030	-0.527***
Parent Smoking	0.690	0.778	-0.088***
Childhood Health			
Depression	0.044	0.050	-0.006***
Other Psychol Problems	0.012	0.015	-0.003***
Drug and Alcohol use	0.018	0.013	0.005***
Ear Problems	0.065	0.064	0.001
Eye Problems	0.042	0.055	-0.013***
Speech Problems	0.029	0.036	-0.007***
Measles	0.226	0.154	0.072***
Mumps	0.198	0.122	0.076***
Chickenpox	0.775	0.691	0.083***
Asthma	0.084	0.114	-0.030***
Diabetes	0.002	0.005	-0.003***
Respiratory Disease	0.111	0.102	0.009***
Allergy	0.099	0.107	-0.008***
Heart Trouble	0.009	0.019	-0.011***
Epilepsy	0.013	0.013	-0.001
Headache	0.072	0.086	-0.014***
Stomach Problems	0.039	0.045	-0.007
High Blood Pressure	0.003	0.005	-0.002***
Obs.	356,854	74,388	

Notes: *** p<0.01, ** p<0.05, * p<0.1

4. Methodology

We explore a fuzzy RD design to identify the effects of early-life access to SNAP on adult mental health. It is fuzzy because of two main reasons. First, 130% FPL is the federal test of SNAP qualification, while a number of states lose this qualification to 165% FPL, 185% FPL and 200% FPL. Second, the eligibility criteria for households eligible for non-cash TANF or state maintenance of effort funded benefit (which is

also referred to as broad-based categorical eligibility (BBCE)) as well as the eligibility criteria for households with elderly or disabled members, are comparatively less stringent than the general financial eligibility for standard SNAP applicant households.

The eligibility of getting access to SNAP during childhood primarily depends on whether individual's parental household gross income is at or below 130% FPL. If their parental household income is less than or equal to 130% FPL, individuals have higher probabilities to get access to SNAP during childhood; if the income is above 130% FPL, individuals have lower probabilities to get access to SNAP during childhood. One crucial premise for fuzzy RD is whether there is discontinuity in the probability of treatment (SNAP participation in this study) around the cut-off.

Since individuals in our study participated in SNAP at varying years during their childhood, our methodology involves selecting only the initial participation in SNAP and assigning a corresponding 130% FPL based on the year of initial participation. For those who did not participate in SNAP, we assign the 130%FPL based on the year of their household's median income during childhood. We then plot the childhood SNAP participation rates across the distance between childhood household income and 130% FPL in the assigned year. The distance is deflated to real terms based on the year 2015. As is shown in the plotted SNAP participation rate of childhood households for sampled individuals (Figure 3), there is a significant discontinuity at 130% FPL. In addition, the figure shows that households below 130% FPL have a higher SNAP participation rate than households above 130% FPL.

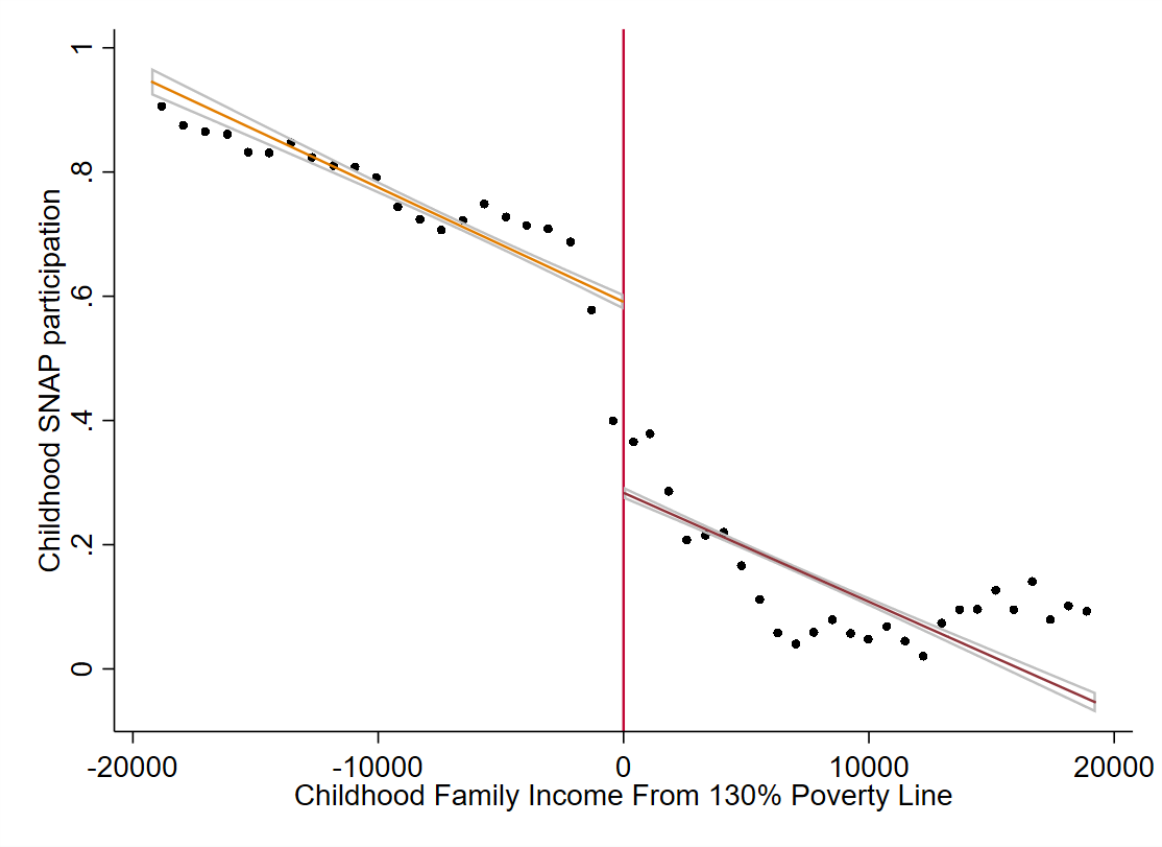

Figure 2. The Discontinuity of SNAP Participation Rate across Income

The first-stage equation, assumed in a linear form, can be expressed as

$$SNAP_{i_H} = \gamma_1 + \gamma_2 income_H + \pi Z_{i_H} + \boldsymbol{\kappa_3 X_{i_H}} + \sigma_{s_H} + \sigma_b + \varepsilon_{i_H} \quad (1),$$

where $SNAP_{i_H}$ represents the childhood SNAP participation status of individual i whose parental household is H. The variable $income_H$ indicates the income of parental household H. Z_{i_H} is the dummy instrument that indicates the point where the probability of individual i getting access to SNAP in childhood is discontinuous conditional on the parental household income. Especially, $Z_{i_H} = 1(income_H \leq 130\%\ FPL)$, and π is the first-stage effect of Z_{i_H}.

The fuzzy RD reduced form is the regression of the adult mental health outcome $MentalPr_{it}$ on the instrument Z_{i_H} and the running variable which is the parental household income $income_H$. Because the cut-off, 130% FPL, is changing across years, the running variable in the estimation is the difference between the parental household income and 130% FPL. In Figure 5, we plot the mental health variable and the running variable, and there is small but significant kink in the mental health around the 130% FPL.

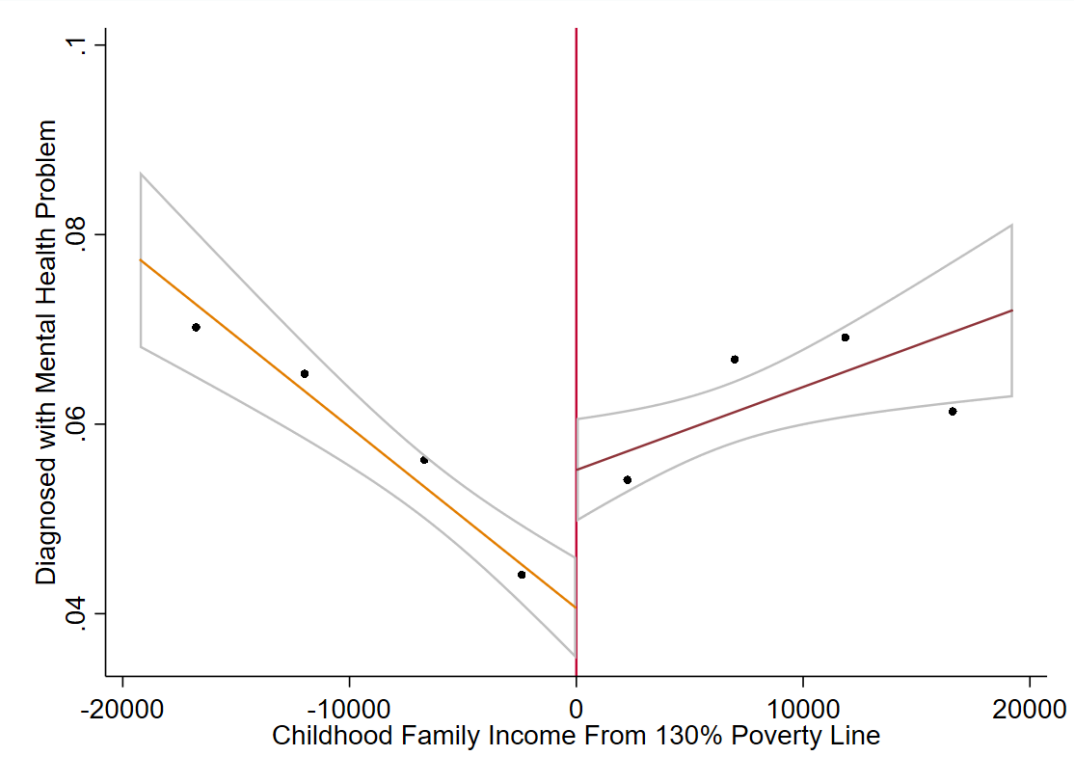

Figure 3. Discontinuity in Diagnosed Mental Health Problems in Adulthood

Therefore, the fuzzy RD reduced form is obtained as follows.

$$MentalPr_{it} = \kappa_1 + \kappa_2 income_H + \delta Z_{i_H} + \boldsymbol{\kappa_3 X_{it}} + \sigma_s + \sigma_b + \sigma_t + \epsilon_{i_H t} \quad (2),$$

where $MentalPr_{it}$ is 1 if individual i is diagnosed with any emotional, nervous or psychiatric problems in year t, and δ is the local average treatment effect (LATE) of childhood access to SNAP on adult mental health, and

$$\delta = \frac{\lim_{income \downarrow 130\%FPL} E[MentalPr|income = 130\%FPL] - \lim_{income \uparrow 130\%FPL} E[MentalPr|income = 130\%FPL]}{\lim_{income \downarrow 130\%FPL} E[SNAP|income = 130\%FPL] - \lim_{income \uparrow 130\%FPL} E[SNAP|income = 130\%FPL]} \quad (3).$$

In the empirical estimation, we add covariates including 1) individual variables in the adulthood: age, age square, gender, marital status, race, family size, education; 2) individual variables in the childhood: the marital status of the head of childhood family, the education attainment of the head of childhood family, numbers of siblings. In addition, we also childhood state fixed effect, σ_s, adulthood state fixed effect, σ_b, and year fixed effect, σ_t. The standard errors are clustered at the childhood state level.

Since childhood SNAP participation is endogenous, we conduct an instrument variable, the difference between parental household income and 130% FPL. The instrument variable is also the running variable in the fuzzy RD design. For the treatment group, individuals who participate in SNAP in their childhood, we use the parental household income in the year when they first participate in SNAP to construct the instrument, while for the control group, individual who did not participate in SNAP in their childhood, we use the lowest parental household income across their childhood to construct the instrument. At last, we perform the 2SLS method to estimate local average treatment effect δ.

5. Results

5.1 Results of the Average Treatment Effect

Table 3 presents estimates of the treatment effect of childhood participation in SNAP on adulthood diagnosed mental health disorders using OLS, fixed effect and 2SLS estimation approaches. The OLS and fixed effect estimates are smaller than 2SLS estimates are negative. All the estimates are statistically significant at least at the 5% significance level. However, the estimates using OLS and simple fixed-effect methods are biased without addressing endogeneity issues of SNAP participation. In the 2SLS estimation, childhood SNAP participation is instrumented by the 130% FPL cutoff of parental family income. After controlling for covariates and fixed effects, the local average treatment effect of access of SNAP in childhood on adulthood diagnosed mental health problems, as shown in column 4, is -0.039, which implies that childhood participation in SNAP reduces adulthood diagnosed mental health disorders by 3.9 percentage points, compared to a mean of 6.3 percent.

Table 3 also reports the first-stage estimation for the 2SLS estimation. Regressing the endogenous variable on the instrument variable, we find parental family income above 130% FPL significantly decreases the participation in SNAP for the children. The F-statistics and Chi-sq statistic reject the weak instrument and weak identification hypothesis and confirmed that the difference between parental family income and the 130% FPL is a strong instrument for childhood SNAP participation.

By employing the same model setting, we also find a notable influence of childhood participation in SNAP on the age at which individuals first became cognizant of their mental health issues. Specifically, individuals who receive SNAP benefits during their childhood evince such diagnoses seven years earlier than their non-participating peers (Table 4).

Table 3. Effects of Childhood Participation in SNAP on the Adulthood Diagnosed Mental Health Problem

	(1)	(2)	(3)	(4)
VARIABLES	OLS	Fixed Effects	2SLS	2SLS

Dependent variable: Whether diagnose mental health problems				
SNAP before age 18	-0.018***	-0.019**	-0.052***	-0.039**
	(0.006)	(0.007)	(0.020)	(0.016)
First Stage for the 2SLS estimation				
Dependent Variable: SNAP before age 18				
Income difference to the 130% FPL			-0.258**	-0.339***
			(0.086)	(0.022)
F-statistic for the excluded instrument test			94.53***	29.55***
Cragg-Donald Wald F-statistic			70.4***	4545.8***
Anderson-Rubin Wald F-statistic			8.26***	4.70**
Chi-sq for the under-identification test			95.15***	25.42***
Covariates	Y	Y	N	Y
Childhood State FE	N	Y	N	Y
Adulthood State FE	N	Y	N	Y
Year Fixed Effects	N	Y	N	Y
Childhood State Clusters	Y	Y	N	Y
Observations	30,732	30,732	30,732	30,732
R-squared	0.001	0.070	0.000	0.059

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 4. Effects of Childhood Participation in SNAP on the Age First Diagnosed of Mental Health Problem

	(1)	(2)
VARIABLES	2SLS	2SLS
Dependent variable: Age First Diagnosed Mental Problems		
SNAP before age 18	-10.236*	-7.339**
	(5.855)	(3.169)
First Stage for the 2SLS estimation		
Dependent Variable: SNAP before age 18		
Income difference to the 130% FPL	-0.306	-0.346***
	(0.060)	(0.039)
Covariates	N	Y
Childhood State FE	N	Y
Adulthood State FE	N	Y
Year Fixed Effects	N	Y
Childhood State Clusters	N	Y
Observations	795	795

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

6. Robustness Checks

6.1 Density tests for manipulation and bunching

The validity for a RD design hinges on continuity assumption, which requires that units are smoothly distributed around the cut-off point (Cattaneo, et al., 2020). From Figure 2, the charted density distribution of childhood family income does not exhibit a significant bunching around the 130%FPL. To rigorously assess the manipulation, we further employ the McCrary's density test (Cattaneo, et al., 2018, McCrary, 2008), with the null hypothesis is being that the density is continuous at the cutoff point. The resulting robust T-statistic equates to -1.515 (p-value = 0.130), indicating that we cannot reject the null hypothesis at the 95% confidence interval. Hence, we confirm that the density is continuous at the 130% FPL with 95% confidence.

6.2 Covariate balance tests around the cutoff

Following Lee, et al. (2004), we plot six childhood covariates over the running variable; education years for household head in childhood household, whether having depression in childhood, age diagnosed with mental health disorders, whether having difficulty in seeing as a child, whether having speech impediment as a child, and whether having ear problems as a child. We then draw the predicted fitness line in Figure 4. The bandwidth and other settings hold the same as these in the main result. The lines above and below the fitness lines represent 95% confidence intervals. For the selected covariates, we cannot deny the hypothesis that the covariates are continuous around the 130% FPL at the 5% significance level.

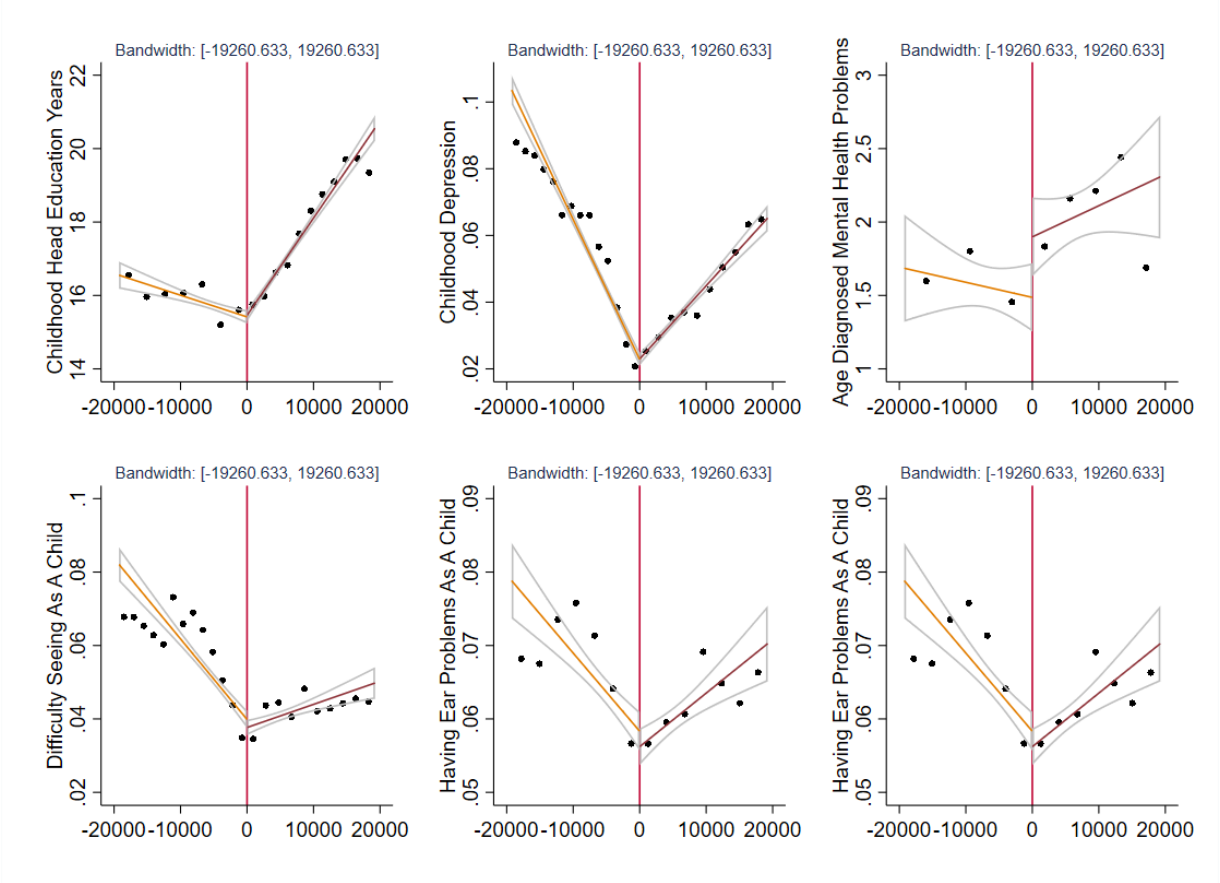

Figure 4. Covariates Balance Tests

6.3 Alternative Cut-offs

For different cut-offs, we find interesting results. Generally, there are large or small discontinuities in SNAP participation around FPL, 165%FPL, 185%FPL and 200%FPL. Around FPL and 165%FPL, the local average treatment effects of participating in SNAP during childhood are not significant. However, around 185% FPL and 200%FPL, childhood participation in SNAP increases adulthood diagnosed mental health disorders, which is contradictory to our main results. There are possible reasons leading to these results. On the one hand, the individuals around the cut-offs have higher income than individuals around the 130%FPL, these controversy results merely show that participation in SNAP has heterogeneous results across income. On the other hand, in some states, people who are favored by the 185% and 200% FPLs are people whose households have senior and disabled household members. Children from those households may have a different situation and environment than other children.

Table 5. Effects of Childhood Participation in SNAP on the Adulthood Diagnosed Mental Health Problem

	(1)	(2)	(3)	(4)
VARIABLES	FPL	165%FPL	185%FPL	200%FPL
Dependent variable: Whether diagnose mental health problems				
SNAP before age 18	-0.408	-0.027	0.092**	0.095***
	(0.248)	(0.008)	(0.043)	(0.033)
First Stage for the 2SLS estimation				
Dependent Variable: SNAP before age 18				
Income difference to the cut-offs	-0.064*	-0.307***	-0.199***	-0.206***
	(0.034)	(0.019)	(0.043)	(0.019)
Covariates	Y	Y	Y	Y
Childhood State FE	Y	Y	Y	Y
Adulthood State FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Childhood State Clusters	Y	Y	Y	Y
Observations	30,732	30,732	30,732	30,732
R-squared				

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

6.4 Alternative format settings

We choose local quadratic regression as a robustness check in addition to the local linear regression in our main identification. The results stay robust. In addition to the difference between childhood household income and 130% FPL, we use the ratio between childhood household income and 130% FPL as an alternative running variable. The result stays relatively robust. We also find a significant discontinuity in Childhood SNAP participation around the 130%FPL, while the discontinuity in the mental health problem is negative but not significant.

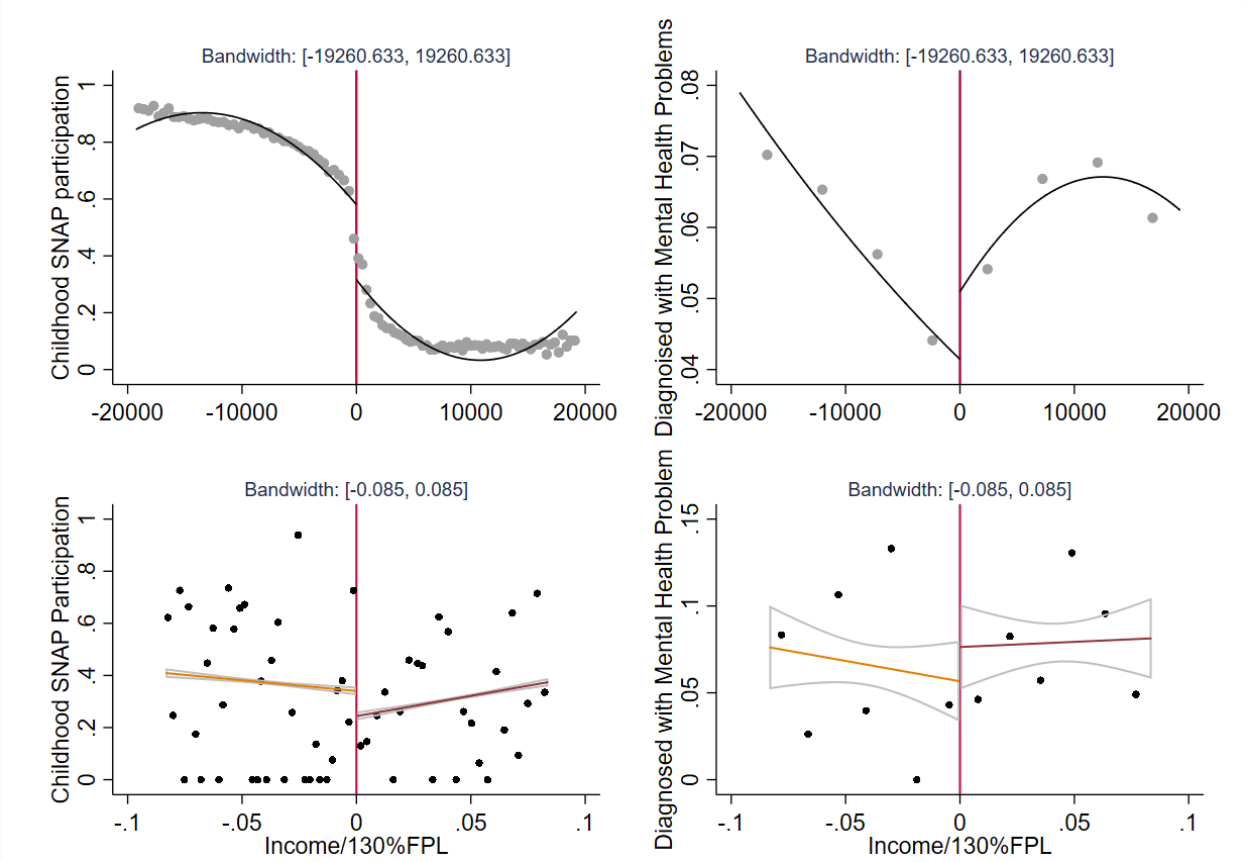

Figure 5 Alternative Format Settings

6.5 Eliminating the Impacts from Free Meal and TANF

Since children whose household participating in SNAP are automatically qualified for free meal and Temporary Assistance for Needy Families (TANF) programs, it is possible to eliminate the impacts from participation free meal and TANF programs. Therefore, we exclude individual samples who participate in the free meal or TANF programs during their childhoods. Results stayed robust, as is shown in Table 6.

Table 6. Robustness Checks for Samples without Impacts from Free Meal and TANF Programs

	(1)	(2)
VARIABLES	Diagnosed Mental Illnesses	Age having diagnosed mental illnesses
RD_Estimate	-0.038**	-14.426**
	(0.017)	(6.053)
Covariates	Y	Y
Childhood State FE	Y	Y
Adulthood State FE	Y	Y
Year FE	Y	Y

Childhood State Clusters	Y	Y
Observations	28,298	669

Notes: Standard errors are clustered at the childhood state clusters in parentheses. *** p<0.01, ** p<0.05, * p<0.1

7. Heterogeneous Effects

7.1 Mental Illnesses

Table 6 presents estimates for decomposed mental health disorders. Childhood participation in SNAP has significant impacts on reducing diagnosed depression, mania and OCD in adulthood. However, it could also increase diagnosed schizophrenia and anxiety in adulthood, though both estimates are not significant. Furthermore, it could also reduce alcohol and drug abuse, PTSD, phobias and other mental health disorders, but the impacts are not significant.

Table 7. Effects of Childhood Participation in SNAP on Decomposed Mental Health Illnesses in Adulthood

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARIABLES	Depression	Mania	Schizophrenia	Anxiety	Alcohol &Drug Abuse	OCD	PTSD phobias &others
SNAP before age 18	-0.022**	-0.008*	0.005	0.005	-0.001	-0.003*	-0.010
	(0.009)	(0.005)	(0.004)	(0.009)	(0.001)	(0.001)	(0.006)
Covariates	Y	Y	Y	Y	Y	Y	Y
Childhood State FE	Y	Y	Y	Y	Y	Y	Y
Adulthood State FE	Y	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y	Y
Childhood State Clusters	Y	Y	Y	Y	Y	Y	Y
Observations	30,732	30,732	30,732	30,732	30,732	30,732	30,732

Notes: Standard errors are clustered at the childhood state level in parentheses *** p<0.01, ** p<0.05, * p<0.1

7.2 SNAP participation age (0-6, 6-12, 12-18)

Table 7 shows heterogeneous effects of SNAP participation age on diagnosed mental health disorders. We also find that earlier participation age has more significant effects on reducing diagnosed mental health disorders. Even though SNAP participation from age 6 to age 18 still has negative effect on reducing diagnosed metal health illnesses, these estimates are not significant.

In another robustness check, we include individuals who participated in SNAP during their childhood and adulthood and find that participating in SNAP during childhood doesn't help with mental health in the adulthood. On the contrary, it leads to a 2-percent point increase in adulthood diagnosed mental health disorders. Though this is not statistically significant.

Table 8. Heterogeneous Effects of SNAP Participation Age on Diagnosed Mental Health Illnesses

VARIABLES	(1) SNAP (0-6)	(2) SNAP (6-12)	(3) SNAP (12-18)	(4) SNAP (Adult)
Dependent variable: Whether diagnose mental health problems				
SNAP before age 18	-0.071**	-0.120	-0.060	0.020
	(0.031)	(0.143)	(0.086)	(0.044)
First Stage for the 2SLS estimation				
Income difference to the cut-offs	-0.243***	-0.172***	-0.132***	-0.162***
	(0.021)	(0.024)	(0.021)	(0.271)
Covariates	Y	Y	Y	Y
Childhood State FE	Y	Y	Y	Y
Adulthood State FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Childhood State Clusters	Y	Y	Y	Y
Observations	24,398	20,631	19,441	54,641

Notes: Standard errors in parentheses are clustered at the childhood state level; *** p<0.01, ** p<0.05, * p<0.1

8. Conclusion and Discussion

Our study provides a strong piece of evidence on the effects of SNAP on mental health. While previous research has established the significant positive effects of SNAP in combating food insecurity and improving physical well-being, the evidence regarding its influence on mental health has been mixed. Our study finds a causal relationship, indicating that childhood participating in SNAP can indeed enhance mental health in adulthood. Especially, we conduct the fuzzy RD by employing the threshold of 130% FPL as the cut-off for childhood SNAP participation. Utilizing this instrument, our 2SLS estimates demonstrate a substantial reduction in diagnosed mental health disorders in adulthood, particularly in depression, mania, and OCD, caused by childhood participation in SNAP. In addition, we find that accessing SNAP before the age of six yields significant benefits in mental health, whereas participation during adulthood may have adverse effects. Furthermore, our study offers a novel explanation for the mechanism behind the positive impact of early-life access to SNAP on later mental well-being: individuals who participate in SNAP during their childhood develop an earlier awareness of mental health issues. To ensure the robustness of our findings, we subject them to various tests, including density tests, covariate balance test, and alternative samples and model settings.

While our study provides valuable insights, we acknowledge certain limitations in terms of the external validity of our results. By using the methodology of RD, our estimates are local estimates that are applicable

only to individuals falling within the optimal bandwidth around the 130%FPL cut-off. It is important to note that many states expand the gross income eligibility threshold to 165% FPL, 185% FPL and 200% FPL, introducing additional complexities. Therefore, we find these cut-offs also pass the discontinuity tests for childhood SNAP participation.

Looking forward, our study lays the groundwork for further exploration and investigation into the long-term effects of social welfare programs on mental health outcomes. While we have provided robust evidence of the positive impact of SNAP participation during childhood on adult mental well-being, there are still important avenues to explore. Future research could delve into understanding the underlying mechanisms through which SNAP influences mental health, such as exploring the role of nutritional factors, social support, or access to healthcare services. Additionally, examining the potential interaction between SNAP and other interventions targeting mental health, such as therapy or counseling, could provide valuable insights into the most effective strategies for promoting mental well-being among low-income individuals. By expanding our knowledge in this domain, we can develop more comprehensive policies and interventions that address the intricate relationship between socioeconomic factors and mental health outcomes, ultimately fostering a healthier and more equitable society.

Appendix:

Proof of the cut-off as the instrument.

The explicit probability of whether individual i getting access to SNAP in her childhood is expressed as follows:

$$P(SNAP_i = 1|income_H) = \begin{cases} g_1(income_H) & if\ income_H \leq 130\%\ FPL \\ g_0(income_H) & if\ income_H > 130\%\ FPL \end{cases} \quad (1),$$

where H represents parental household of individual i, and $income_H$ represents the corresponding parental household income. $g_1(income_H)$ and $g_0(income_H)$ are the probability functions of individual i having access to SNAP depending on her parental household income. We assume linear forms for g_1 and g_0 in our main strategy: $g_1(income_H) = \alpha_1 + \alpha_2 income_H$, $g_0(income_H) = \beta_1 + \beta_2 income_H$.From Figure 1, the data suggests that $g_1(income_H) > g_0(income_H)$, and $g_1(130\%\ FPL) > g_0(130\%\ FPL)$. Consequently, the relation between the probability of getting access to SNAP in childhood and parental household income is written as

$$\begin{aligned} E(SNAP_i = 1|income_H) &= g_0(income_H) + [g_1(income_H) - g_0(income_H)]T_i \\ &= \beta_1 + \beta_2 income_H + (\alpha_1 - \beta_1)T_i + (\alpha_2 - \beta_2) income_H T_i \end{aligned} \quad (2),$$

where $T_i = 1(income_H \leq 130\%\ FPL)$. T_i is a dummy variable that indicates the point where $E(SNAP_i = 1|income_H)$ is discontinuous. From the explicit function, we can see that T_i and $income_H T_i$ can be used as instrument for SNAP.

Reference

Adynski, H., T.A. Schwartz, and H.P. Santos. 2020. "Does Participation in Food Benefit Programs Reduce the Risk for Depressive Symptoms?" *Journal of the American Psychiatric Nurses Association*:1078390320983904

Aizer, A., H. Hoynes, and A. Lleras-Muney. 2022. "Children and the US social safety net: Balancing disincentives for adults and benefits for children." *Journal of Economic Perspectives* 36:149-174

Alfaro-Hudak, K.M., L. Schulkind, E.F. Racine, and A. Zillante. 2022. "SNAP and Cardiometabolic Risk in Youth." *Nutrients* 14:2756

Andreyeva, T., A.S. Tripp, and M.B. Schwartz. 2015. "Dietary quality of Americans by Supplemental Nutrition Assistance Program participation status: a systematic review." *American journal of preventive medicine* 49:594-604

Bartfeld, J., C. Gundersen, T. Smeeding, and J.P. Ziliak. 2015. *SNAP matters: how food stamps affect health and well-being*: Stanford University Press

Bergmans, R.S., L.M. Berger, M. Palta, S.A. Robert, D.B. Ehrenthal, and K. Malecki. 2018. "Participation in the Supplemental Nutrition Assistance Program and maternal depressive symptoms: Moderation by program perception." *Social science & medicine* 197:1-8

Bitler, M., J. Bartfeld, C. Gundersen, T. Smeeding, and J. Ziliak. 2015. "The health and nutrition effects of SNAP." *SNAP matters: How food stamps affect health and well-being*:134-160

Booshehri, L.G., and J. Dugan. 2021. "Impact of the supplemental nutritional assistance program on diet-related disease morbidity among older adults." *Health services research* 56:854-863

Card, D., C. Dobkin, and N. Maestas. 2008. "The impact of nearly universal insurance coverage on health care utilization: evidence from Medicare." *American Economic Review* 98:2242-2258

Carlson, S., and B. Keith-Jennings. 2018. "SNAP is linked with improved nutritional outcomes and lower health care costs." *Washington, DC: Center on Budget and Policy Priorities*:1-19

Cattaneo, M.D., M. Jansson, and X. Ma. 2018. "Manipulation testing based on density discontinuity." *The Stata Journal* 18:234-261

---. 2020. "Simple local polynomial density estimators." *Journal of the American statistical Association* 115:1449-1455

de Cuba, S.A.E., A.R. Bovell-Ammon, J.T. Cook, S.M. Coleman, M.M. Black, M.M. Chilton, P.H. Casey, D.B. Cutts, T.C. Heeren, and M.T. Sandel. 2019. "SNAP, young children's health, and family food security and healthcare access." *American journal of preventive medicine* 57:525-532

Fang, D., M.R. Thomsen, and R.M. Nayga. 2021. "The association between food insecurity and mental health during the COVID-19 pandemic." *BMC public health* 21:1-8

Gregory, C.A., and P. Deb. 2015. "Does SNAP improve your health?" *Food Policy* 50:11-19

Gundersen, C., B. Kreider, and J. Pepper. 2011. "The economics of food insecurity in the United States." *Applied Economic Perspectives and Policy* 33:281-303

Gundersen, C., B. Kreider, and J.V. Pepper. 2017. "Partial identification methods for evaluating food assistance programs: a case study of the causal impact of SNAP on food insecurity." *American Journal of Agricultural Economics* 99:875-893

Gundersen, C., and J.P. Ziliak. 2015. "Food insecurity and health outcomes." *Health affairs* 34:1830-1839

Han, J. 2020. "SNAP Expansions and Participation in Government Safety Net Programs." *Economic inquiry* 58:1929-1948

Heflin, C.M., and J.P. Ziliak. 2008. "Food insufficiency, food stamp participation, and mental health." *Social Science Quarterly* 89:706-727

Hoynes, H., and D.W. Schanzenbach (2015) "US food and nutrition programs." In *Economics of Means-Tested Transfer Programs in the United States, Volume 1*. University of Chicago Press, pp. 219-301

Hoynes, H., D.W. Schanzenbach, and D. Almond. 2016. "Long-run impacts of childhood access to the safety net." *American Economic Review* 106:903-934

Hoynes, H.W., and D.W. Schanzenbach. 2009. "Consumption responses to in-kind transfers: Evidence from the introduction of the food stamp program." *American Economic Journal: Applied Economics* 1:109-139 DOI: 10.1257/app.1.4.109.

Huang, C., M.R. Phillips, Y. Zhang, J. Zhang, Q. Shi, Z. Song, Z. Ding, S. Pang, and R. Martorell. 2013. "Malnutrition in early life and adult mental health: evidence from a natural experiment." *Social science & medicine* 97:259-266

Lee, D.S., E. Moretti, and M.J. Butler. 2004. "Do voters affect or elect policies? Evidence from the US House." *The Quarterly Journal of Economics* 119:807-859

Leung, C.W., E.S. Epel, W.C. Willett, E.B. Rimm, and B.A. Laraia. 2015. "Household food insecurity is positively associated with depression among low-income supplemental nutrition assistance program participants and income-eligible nonparticipants." *The Journal of nutrition* 145:622-627

Mabli, J., and J. Ohls. 2015. "Supplemental Nutrition Assistance Program participation is associated with an increase in household food security in a national evaluation." *The Journal of nutrition* 145:344-351

McCrary, J. 2008. "Manipulation of the running variable in the regression discontinuity design: A density test." *Journal of econometrics* 142:698-714

McIntyre, L., J.V. Williams, D.H. Lavorato, and S. Patten. 2013. "Depression and suicide ideation in late adolescence and early adulthood are an outcome of child hunger." *Journal of affective disorders* 150:123-129

Melo, G., P. Valizadeh, and R.M. Nayga Jr. 2023. "Did mental and emotional health of SNAP families' children improve during the COVID-19 pandemic?" *Preventive medicine* 169:107456

National Alliance on Mental Health (2022) "Mental Health By the Numbers." In. https://www.nami.org/mhstats

National Institutes of Health (2015) "Annual total direct and indirect costs of serious mental illness (2002)." In.

--- (2022) "Mental Health Information-Statistics." In N.I.o.M. Health ed. https://www.nimh.nih.gov/health/statistics

Oddo, V.M., and J. Mabli. 2015. "Association of participation in the Supplemental Nutrition Assistance Program and psychological distress." *American journal of public health* 105:e30-e35

Olds, G. 2016. *Food stamp entrepreneurs*: Harvard Business School

Pak, T.-Y., and G. Kim. 2020. "Food stamps, food insecurity, and health outcomes among elderly Americans." *Preventive medicine* 130:105871