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Is less more? Examining the relationship between food assistance benefit levels and childhood weight

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ABSTRACT

Background: The Supplementary Nutrition Assistance Program (SNAP) is a critical lifeline for millions of low-income US families, but some studies suggest that it may inadvertently increase obesity risk. Building on research contesting the SNAP-obesity link, we examine the effect of SNAP participation on BMI among multiyear participants at varying levels of SNAP benefit levels to provide some of the first evidence on the relationship between SNAP participation, state-level SNAP resources, and body weight. We focus on children given the strong links between early-life obesity and later-life health.

Methods: Linking state-level data on SNAP benefit levels with three waves of longitudinal individual-level data from the Child Development Supplement of the Panel Study of Income Dynamics, we use child- and state-level fixed effects to examine whether exogenous differences in SNAP benefit allotments influence the relationship between SNAP participation and weight gain.

Results: Lower SNAP benefit levels were associated with only modest increases in BMI among children; higher benefit levels showed no association with BMI.

Conclusions: Although concerns that more food assistance promotes obesity have spurred calls for cuts in the SNAP program, we find the opposite — that SNAP participation is associated with an increase in childhood BMI only when benefit levels are low. This study adds to the mounting evidence suggesting that SNAP does not cause obesity. It also contributes to the literature on the political economy of health, especially that pertaining to social policy variation across US states.

1. Introduction

1.1. Study objective

The Supplemental Nutrition Assistance Program (SNAP), formerly known as the Food Stamps Program, is the largest safety-net program in the country, providing benefits to 42 million of the nearly 50 million Americans who were eligible (Gray & Cunningham, 2017). SNAP was developed as a program to end hunger and malnourishment among low-income Americans, and for nearly a half-century operated under the objective of increasing food consumption (Kennedy & Guthrie, 2016).

This objective implied a “more is better” approach to benefit amounts. The relative generosity of SNAP benefits, especially in relation to other safety net programs such as Temporary Assistance for Needy

Families, kept 10.3 million people out of poverty in 2012, including 4.9 million children (Keith-Jennings & Palacios, 2017).

With the rise of the obesity epidemic and its concentration among poor populations over recent decades (Drewnowski & Specter, 2004), however, SNAP’s ‘more is better’ approach has come under increasing criticism. By increasing the overall budget for food in a household, some scholars allege that SNAP participation allows consumption of more unhealthy foods (Leung et al., 2013; Nguyen, Shuval, Njike, & Katz, 2014). At the state level, proposals have been advanced aimed at limiting what SNAP benefits can purchase, including excluding pre-processed food that is high in calories and low in nutritional content (junk foods) (Holley, 2016). At the federal level, as a \$70 billion public program, SNAP has continually come under pressure for budget cuts (Belluz, 2017). In addition, the US House of Representatives recently

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passed a bill that would include work requirements for SNAP participation, which could lead to the loss of benefits for millions of poor people (Dewey, 2018b). Finally, the current administration is proposing distributing federal SNAP funds as block grants to states and replacing the present electronic benefits transfer system with a “food box” that would contain nonperishable items but no fresh fruits or vegetables (Dewey, 2018a).

In order to determine the appropriate way forward for this widely-used safety net program, we must better understand the relationship between SNAP benefit levels, not just SNAP program participation, and weight gain. Our study aims to fill this research gap.

1.2. Background

An estimated one in six children in the United States was considered food-insecure in 2015, even as 18.5% of children were considered overweight or obese that same year (Schanzenbach & Bauer, 2017). One way that researchers have reconciled these seemingly paradoxical findings of food insecurity coinciding with obesity is with the “food stamp cycle” theory, wherein the anticipation of hunger leads to more hoarding and calorie-dense eating when food is available (Hamrick & Andrews, 2016; Hastings & Washington, 2008; Smith, Berning, Yang, Colson, & Dorfman, 2016). Epigenetic research also suggests that there may be a biological mechanism at play. Studies following mass famines have shown that maternal malnutrition during pregnancy can affect their unborn offspring’s later life obesity due to an increased sensitivity to obesogenic environments that develops in utero as a response to anticipated nutritional deficits (Gluckman & Hanson, 2008; Parlee & MacDougald, 2014).

Given its potential for alleviating food insecurity among low-income populations, health scholars have focused substantial attention on the relationship between SNAP participation and obesity. SNAP benefits are “near-cash”, delivered via an electronic benefit transfer system that loads the monthly supplement onto a debit card for use at participating retailers. Funds cannot be used to purchase non-food items, alcohol, tobacco or prepared foods. Families must have gross incomes below 130% of the federal poverty level for a given family size, after allowable deductions. Until recently, individuals with and without children were eligible for benefits, although reform is underway to restrict able-bodied adults without dependents from qualifying unless they are working a minimum of 20 h per week. Variation in state macro-economic conditions generate variation in the value of benefits (see below for a more detailed discussion), but benefits across families of the same composition and economic circumstances within a state are uniform.

Counter to expectations, some research on the subject has found SNAP to be correlated with higher bodyweight (DeBono, Ross, & Berrang-Ford, 2012 for a systematic review). Much of this initial research, however, employed cross-sectional designs that are limited in their ability to address probable selection issues (Hudak & Racine, 2019). For instance, SNAP participants differ from eligible non-SNAP participants in terms of resource deprivation (i.e. – food security, income adequacy and multi-program participation) and nutritional profiles (Grummon & Taillie, 2017; Kaiser, 2008), both of which are strongly correlated with risk of obesity. Moreover, survey-based studies of safety net program effects are plagued with problems of misreporting (Mittag, 2019). Estimates suggests as little as two-thirds of SNAP dollars or benefit months are reported in major household surveys (Meyer, Mok, & Sullivan, 2009). More recent studies addressing these potential sources of bias provide significantly less support for the notion that SNAP participation is causally related to obesity (Almada, McCarthy, & Tchernis, 2016; Kreider, Pepper, Gundersen, & Jolliffe, 2012; Rigdon, Berkowitz, Seligman, & Basu, 2017; Vassilopoulos, Drichoutis, Nayga Jr., & Lazaridis, 2018). Studies using longitudinal data, in particular, were more likely to show a null or, especially among previously unexamined subgroups, beneficial effect of SNAP participation (Baum, 2012; Fan, 2010; Fan & Jin, 2015; Hoynes, Schanzenbach, & Almond, 2016;

MacEwan, Smith, & Alston, 2016). Reviews of the literature provide especially compelling accounts contradicting stubborn and fallacious assumptions about the health-compromising effects of food assistance (Bitler, 2014; Gundersen, 2015).

Furthermore, mounting evidence on the political economy of health suggests that the association between SNAP and obesity is more likely to be attributable to benefit levels that are too low rather than too high. Cross-national literature comparing different kinds of welfare states generally finds that greater social welfare spending is associated with better population health (Beckfield & Bamba, 2016; Eikemo, Bamba, Judge, & Ringdal, 2008; Reynolds & Avendano, 2018). Emerging research on variations in aggregate social spending within the US echoes cross-national conclusions (Bradley et al., 2016; Kim, 2016; Rubin et al., 2016). By allocating additional resources with which socioeconomically disadvantaged individuals can combat food insecurity, financial hardship, and stress, welfare spending mitigates some of the risk factors to which health is inextricably linked (Beckfield et al., 2015; Pollack, 2008).

Higher SNAP benefit levels have the potential to promote healthy weight through a variety of mechanisms, including, but not limited to, the amelioration of food insecurity. Whether direct or mediated through dietary behavior (Gundersen, Garasky, & Lohman, 2009; Larson & Story, 2011), as described above, food insecurity remains strongly associated with obesity and the effects of SNAP in reducing food insecurity are well-demonstrated (Ettinger de Cuba et al., 2019; Gundersen & Ziliak, 2015; Schmidt, Shore-Sheppard, & Watson, 2016). SNAP also has the potential to free up funds that might otherwise have been allocated to food (Edin et al., 2013; Hoynes & Schanzenbach, 2009). Deficits in financial resources have been shown to deter healthcare use (Centers for Disease Control, 2010; Kalousova & Burgard, 2013), which can translate into missed opportunities for prevention and treatment of obesity and its correlates. Finally, higher benefit levels may promote healthy weight by reducing economic strain, which been shown to be a common stressor in the lives of low-income individuals (Pearlin, Menaghan, Lieberman, & Mullan, 1981; Turner, Wheaton, & Lloyd, 1995). Such stressors can result in malfunction of metabolic processes through the accumulation of “allostatic load”, wherein neural, neuro-endocrine, and neuroendocrine-immune responses to stressors become over-activated (McEwen, 1998; Seeman, Singer, Rowe, Horwitz, & McEwen, 1997). In addition to physiologically damaging stress responses, stress also contributes to unhealthy behaviors, such as poor eating habits, which can act as coping mechanisms (Krueger & Chang, 2008; Ng & Jeffery, 2003).

Our study combines the strengths of a longitudinal estimation strategy with data on exogenous variation in the size of the SNAP benefit package across states to better isolate the impact of SNAP on child weight over time. We interact this state-level SNAP benefit level measure with family-level SNAP participation to identify whether the exogenous differences in SNAP benefit allotments influence the relationship between SNAP participation and weight gain. If it were the case that SNAP is associated with obesity because it affords greater resources to procure “junk foods,” we would expect that SNAP participation should be associated with weight gain and that receiving a higher benefit amount should produce significantly greater weight gain over the three time periods compared with individuals receiving a lower benefit amount. This design constitutes an improvement upon prior studies of the SNAP-obesity link that have relied exclusively on measures of individual program participation (for a notable exception see Almada & Tchernis, 2018).

We focus on obesity during childhood because its incidence is linked with later-life morbidity and premature mortality via increased risk of cardiometabolic disease (hypertension, stroke, heart disease, and diabetes) (Reilly & Kelly, 2011). Our focus on low-income children is necessary to examine the effects of SNAP benefits, for whom only low-income families are eligible. The focus on this group is also warranted based on the disproportionate rates of obesity among low-income

children. Children living below the federal household poverty level have an obesity rate 2.7 times higher (27.4%) than children living in households exceeding 400 percent of the federal poverty level (Singh & Kogan, 2010).

2. Materials and methods

2.1. Data

Our analysis combines data from the Child Development Supplement (CDS-I, CDS-II, and CDS-III) of the Panel of Income Dynamics (PSID) with data on state SNAP benefit levels (Institute for Social Research, 2018). The PSID is a nationally representative longitudinal study gathering data on US individuals and the families in which they reside. The CDS collects data on the same children roughly every five years across three waves from 1997 to 2007. As an extension to the PSID, the CDS provides comprehensive data on family demographic and economic conditions of children aged 0–12 years old and their families. The CDS data is supplemented with income and household composition data from the coinciding PSID family-interview waves. Taken together, these data provide a large sample size of children and their households and a rich source of information on child-level characteristics and family-level context. Information from the three waves of the CDS provide the basis of this study. We combine these longitudinal data with information on the SNAP benefit replacement rate (described below).

2.2. Sample

Our analysis includes children age 5 to 18. We exclude children below the age of 5 because height and weight reports are known to be unreliable below that age (Wedem et al., 2013). We further limited our sample to children who reside in low-income households, as designated by total household income that had ever fallen below 130% of the federal poverty level (FPL) guideline for the survey years 1997–2007. The FPL guideline is a national income rate based on family size that is generated annually by the Department of Health and Human Services and used for administrative purposes, including determining financial eligibility for social safety net programs. We chose the 130% cutoff because federal eligibility guidelines stipulate that a maximum gross income for a family in which there is no disabled or elderly family member must be no higher than this. We focused on children who had at one time experienced an income spell below 130% FPL because we reasoned that most of these children are likely to be at the margins of eligibility in alternate years as well. The full sample of children age 5 or older who are normal weight or above represents 5289 observations across the 3 waves. This shrinks to 1795 observations when we remove children whose families did not experience poverty during the study. Note that fixed effects models do not drop singleton observations but retain them to estimate the constant, the variance components, and each component's R-square. Thus, the sample size for regression analysis is 1795 observations, although the point estimates are derived using only cases with multiple observations (children with 2 observations = 651; children with 3 observations = 1058). The reduction in sample size across waves reflects a variety of factors: (1) the PSID's intentional suspension of cases between Wave 1 and Wave 2 (n = 292); (2) non-participation of eligible families between Waves 1 and 2 (n = 364); (3) became age-ineligible between Waves 2 and 3 (n = 1231); and (4) non-participation of eligible families between Waves 2 and 3 (n = 170). We use Stata version 15 for all estimation.

2.3. Outcome

We chose BMI as our outcome as we wanted to use a definition of undesirable weight gain that was more expansive than a shift into the category of obese. This permitted a more appropriate test of the argument we were interrogating: whether more food assistance necessarily

leads to undesirable weight gain. Admittedly, this approach subsumes some increases that could be viewed as 'neutral development'. But it also allows us to capture increases that could be viewed as undesirable at other places along the distribution. Because there are places along the BMI distribution where weight gain would most certainly constitute 'positive development', we removed from the analysis all children who are underweight (below the fifth percentile), as these cases constitute a theoretically and analytically different scenario than we are examining (417 observations across three waves of data). In other words, we do not want to combine instances where weight gain is a 'good thing' with instances where it is not.

We calculated BMI using the Centers for Disease Control (CDC) BMI-for-age gender-specific growth charts. Missing data for BMI and obese status is just over 10% of observations. Missing data can be explained by (a) invalid height and weight measures at data collection and (b) failure of primary caregivers to report child height or weight. We deleted missing data listwise based on the low risk of bias introduction (Allison, 2014).

2.4. Predictors

At the state level, we focused on *SNAP benefit levels*. Data on SNAP benefit allotments for each state-year were collected from the United States Department of Agriculture. Values represent the average weekly benefit in a given state and year. Importantly, these figures are expressed as amount per enrolled family. Therefore, unlike data that represents payouts in raw or per capita expenditures, our SNAP benefit data accounts for variation in the number of participants across states. To account for variation in local economic conditions, we divided this amount by the median income in each state-year. This step is crucial because local food prices dictate how much food a given family can obtain with their SNAP benefit (Bronchetti, Christensen, & Hoynes, 2019). Moreover, local economic conditions (which we have measured in terms of median income) determine the value of SNAP deductions, which play an important role in the calculation of benefit amounts. These include: gross earnings deduction; dependent care deduction; elderly out-of-pocket medical expense deduction; child support payment allowance. Local economic conditions also influence the income received under other safety net programs, such as Temporary Assistance for Needy Families, which is then used to compute SNAP benefit amounts (Institute of Medicine and National Research Council, 2013). The cumulative effect of these factors produces notable differences in the real value of SNAP benefits across geographic areas. The resulting value represents the percentage of the state's median income that is comprised of SNAP benefits for a notional recipient family in a given state and year. A higher value means a higher SNAP benefit level. At the individual level, our key variable of interest is *SNAP participation*, a dichotomous indicator based on the head-of-household's or their spouse's reported receipt of SNAP benefits during the previous calendar year from the interview.

2.5. Controls

Individual-level covariates include child age, sex and race. We also include head-of-household education level (less than high school, high school, some college, or more than an undergraduate degree), a continuous measure of household income and family size. Our family size variable does not take into account the composition of the family (i. e. – how many productive versus non-productive members in each family). The CDS child's head-of-household *education level* was drawn from the PSID main interview as reported by the head-of-household of the child's family unit. *Education* was reported in years completed. *Household income* is measured as a continuous value and drawn from the PSID main interview as reported by the child's head-of-household. Household income is measured by the total amount of income received in the year before the interview by all persons in the sample

family. This measure of family income includes taxable income, transfer income, and social security income. We also include child fixed effects to account for time-invariant characteristics of children that may be correlated with both propensity for SNAP participation and obesity.

As state-level benefit payouts may be correlated with characteristics of states that may influence both SNAP participation and BMI trends, we controlled for a variety of time-varying state-level covariates. *Poverty rate* is the estimated percent of individuals living in poverty based on pre-tax and transfer income. *Nonwhite* measures the proportion of the population that is nonwhite. *Unemployment rate* is calculated as a percentage, dividing the number of unemployed individuals by all individuals currently in the labor force. Data on these variables were drawn from the University of Kentucky Center for Poverty Research database for the years 1996–2007. Each of these variables has been shown to impact factors strongly linked to health (e.g., educational quality, built environment, economic opportunity, etc.). It is also worth noting that because most individuals do not change state of residence during the study period, the majority of the variance observed occurs within a given state. Because we also include state fixed effects, the effect of heterogeneity in durable state characteristics is minimized.

2.6. Analysis

We merged the child, parent/caregiver, family, and main PSID files to obtain the most comprehensive data on each sample child along with the benefit level measures. Because the reporting period for program participation was the calendar year prior to the survey, we regress BMI in the reporting year on the lagged values of the state-level predictors. Individual-level variables included as controls are either already reported for the prior calendar year or are presumed to be mostly stable between t and $t-1$.

First, we examine chi-square tests of difference for non-SNAP compared to SNAP participants in terms of obesity (Table 1) in order to examine the widely observed descriptive finding of higher rates of obesity among SNAP participants. We then present descriptive statistics for our predictor and outcome variables (mean as well as the standard deviation and minimum and maximum values, where appropriate) across the years for our sample of 1350 children and 48 states (Table 2).

The multivariable analysis (Table 3) used child- and state-level fixed effects estimation to analyze the effect of SNAP participation on BMI by state benefit levels adjusting for time-variant covariates. The model includes an individual SNAP term representing the overall effect of being on SNAP in a given state-year and an interaction between state SNAP benefit levels, which captures how changes in SNAP benefit amount influences the extent to which SNAP participation is associated with an increase in BMI. To improve interpretability of results, we plot marginal effects for each model and display results in Fig. 1.

Following prior efforts to rigorously account for the ways in which unmeasured characteristics may affect selection into the SNAP program, we use child fixed effects models. We also include state fixed effects. These models group-mean center all values, holding all between-individual and between-state variation constant and limiting the

Table 1

Cross-tabulation of individual obesity prevalence by individual SNAP participation across waves, panel study of income dynamics child development supplement (1997, 2002, 2007).

Obesity	Nonparticipant	Participant	Total
Yes	906 21.0%	252 25.7%	1158 21.9%
No	3401 79.0%	730 74.3%	4131 78.1%
Total	4307 100.0%	982 100.0%	5289 100.0%

Pearson Chi-square = 10.01 $p = 0.002$.

Table 2

Individual-level descriptive statistics across waves, panel study of income dynamics child development supplement (1997, 2002, 2007).

	Mean/ %	SD	Min	Max	% Missing*
SNAP benefit level	9.9	1.4	7.0	13.3	0
SNAP weekly payment	\$80.30	\$12.03	\$54.30	\$109.70	0
SNAP participation	18.6	–	–	–	2.0
BMI	21.4	5.9	13.5	62.7	11.9
Obese	21.9	–	–	–	11.9

Table 3

Two-way fixed effects models predicting BMI, panel study of income dynamics child development supplement (1997, 2002, 2007).

Variable	Estimate
SNAP Participation	3.160
SNAP Benefit Level	0.687*
SNAP Participation*SNAP Benefit Level	-0.242
Age	0.882**
Head's Education	-0.063
Household Income	0.000
Family Size	-0.297
Proportion Non-white	-0.176
Unemployment Rate	-0.081
Poverty Rate	0.085
Observations	1795
Clusters	1020

Child- and state-level fixed effects included. Constant not shown.

95% Confidence intervals in parentheses.

* $p < 0.05$; ** $p < 0.01$.

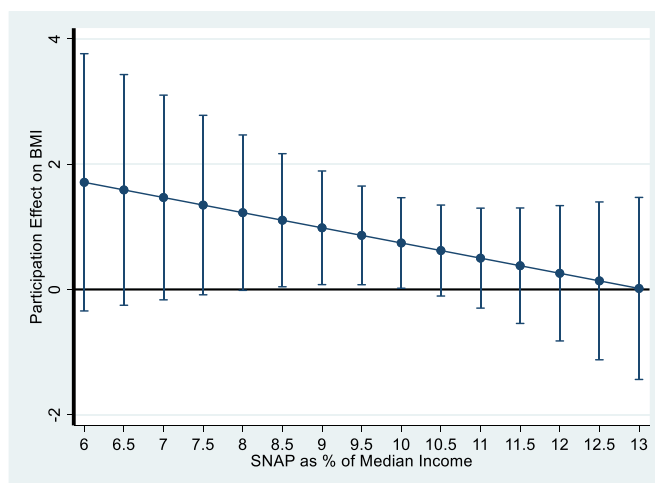


Fig. 1. Marginal Effects of Discrete Change from Non-SNAP to SNAP Participation by State-Level SNAP Generosity using Two-Way Fixed Effects Models, Panel Study of Income Dynamics Child Development Supplement (1997, 2002, 2007).

analysis to variation within the same individual in the same state over time. By limiting the analysis to within-variation only we effectively use the individual and state as their own control to achieve causal identification. This is especially useful in accounting for unobserved heterogeneity between states. One of the main threats to the identification of SNAP benefit levels effects is the existence of other factors that may be correlated with both benefit levels and weight. These include a wide range of macro-economic, political, and demographic factors, as well as variables pertaining to state social ecology. To the extent that these

unobserved factors are stable across time, fixed effects models will help to isolate the effect of changes in SNAP benefit levels from those related to changes in other state-level factors that may co-vary with SNAP benefit levels. This produces a “two-way fixed effects” model, which can be formally expressed as:

$$Y_{ist} = b_0 + b_1 \text{Generosity}_{ist} + b_2 X_{2ist} + \dots + b_k X_{kist} + \lambda_s + \gamma_i + \epsilon_{ist}$$

for individual i in state s at time t , where γ_i represents the covariates, λ_s are state-level fixed effects and ϵ_{ist} are individual-level fixed effects.

3. Results

Table 1 shows the association between individual-level obesity and SNAP participation. We make this comparison using the full sample of children age 5 and above who were normal weight or above, without regard to poverty status; this is to allow for more straightforward comparison to previous research that evaluate rates of obesity among SNAP participants versus the population at large. In the period 1997–2007, the proportion of children who are obese is 4.7 percentage points higher in families receiving SNAP program benefits than among those who are in families not receiving SNAP benefits. This difference is statistically significant ($p = 0.002$), as indicated by the chi-square statistic. This finding accords with prior research suggesting that SNAP participation is associated with obesity either through increased availability of calorie-rich foods (Leung et al., 2013; Nguyen et al., 2014) or the selection of low-income individuals who are already at high risk of obesity into the program (Hudak & Racine, 2019).

Summary statistics (Table 2) reveal a mean of almost 10% of median income replaced by SNAP benefits across state-years. Values range between roughly 7% and 13% of median income and there is substantial variation across state-years, with the standard deviation constituting 14% of the mean. SNAP participation occurs in just under one-fifth of the observations (18.6%). The mean BMI of the sample was in the normal range (21.4) with wide spread ($SD = 5.9$) and a small number of values (1.34%) constituting Class 3 obesity (BMI of 40+) (results not shown). Approximately 22% of the sample was obese based on their BMI.

Table 3 shows the multivariable model for the interaction between individual SNAP participation and SNAP benefit levels independently. This model includes both child- and state-level fixed effects. The interaction effect is negative, but it is not significant. Among those on SNAP, a unit change in SNAP benefits between two waves in a given state was not associated with a statistically significant change in BMI. Neither the main effect of SNAP participation nor SNAP benefit levels are significantly associated with BMI over time, although the meaning of these coefficients are minimally interpretable given the presence of the interaction term.

While the means of SNAP and non-SNAP participants may not differ significantly at all SNAP benefit levels, they might at certain values. To explore this possibility, we generated marginal effects of SNAP participation across the range of SNAP benefit levels, setting all covariates equal to their means. The results are depicted in Fig. 1. Here we see that the participation effect is significantly or nearly significantly positive in the lower half of the benefit distribution, but in the upper half of the benefit distribution, the effect is not significantly different from zero. Falsification tests of the effects of SNAP benefit levels on children who have never experienced a poverty spell during the observation period reveal neither of these significant relationships.

4. Discussion

We employed a quasi-experimental approach to examine the impact of SNAP benefit levels on the association between BMI and SNAP participation. Our study replicates the finding of increased obesity among SNAP participants in chi-square tests of difference. We then

exploit the longitudinal nature of the data to use child- and state-level fixed effects that more rigorously address the potential biases arising from non-random selection into the program. With these more rigorous statistical models, we found that participation is associated with an increase in BMI in children only when SNAP benefit levels are on the low end of the distribution.

Our study adds to the research on SNAP and obesity by revealing that the SNAP-obesity link is conditional upon benefit levels. Previous research has shown that obese individuals select into SNAP program participation, implying that a large part of the observed relationship between obesity and program participation is correlational rather than causal. It is possible that at least part of the apparently adverse effect of SNAP participation can be attributed to the selection of higher-BMI individuals into the program, especially at low benefit levels.

An alternative interpretation of our results is provided by the rapidly growing literature on the political economy of health, especially that pertaining to social policy variation across US states. The finding that SNAP and weight gain appears to exist only at low benefit levels of SNAP supports the emerging consensus that larger social welfare benefits enhance population health. In the case of SNAP, smaller benefit packages may not be adequate to afford the foods that promote healthy weight, thereby leading to higher obesity risk than under larger benefit packages. Given the prevalence of low benefit levels in the United States, this may help to explain the widely observed, although not invariable, link between SNAP and obesity. We suggest that it is worth exploring whether increasing benefit levels among the highest risk groups may, in fact, be salubrious.

Limitations to this analysis should be noted. Our use of exogenous variation in benefit levels goes a long way to addressing the risk of selection bias. The combination of child and state fixed effects models with extensive time-varying covariates significantly further reduces this risk. However, short of random assignment, SNAP participation remains a choice, and we cannot rule out the possibility that our estimates are biased by differences between people who choose to participate and people who do not choose to participate.

Our analysis assumes contemporaneous effects of SNAP benefit levels on BMI. It is, however, possible that what we observe is better explained by a lag model in which the effects of SNAP benefit amounts take hold at some subsequent time. Lifecourse literature around developmental origins and cumulative dis/advantage suggests that effects may manifest or carry through well after exposure and/or depend critically on the timing of such exposure. Research investigating these temporal dynamics with regard to SNAP and obesity support this notion (Almond, Hoynes, & Schanzenbach, 2011; East, 2018; Hoynes et al., 2016). These questions merit focused analysis. Future research should, thus, examine whether/how the size of SNAP benefit packages interact with age of exposure to influence body weight at various points later in life.

Finally, our study does not evaluate whether the nature of the relationship between SNAP participation and BMI based on SNAP benefit levels is the same across different weight groups. For example, it is entirely possible that increased benefit levels is associated with higher BMI among normal-weight SNAP participants but lower BMI among higher-weight SNAP participants if resources allow different groups to attain optimal weight. Our attempts to assess this possibility were limited by the small sample sizes and limited within-variation in disaggregated analyses. Extensions using the PSID Main and Transition to Adulthood files could provide the needed statistical power with which to answer this question.

5. Conclusions

Our analysis finds little support for the idea that increases in obesity among children in households receiving SNAP are attributable to the availability of additional resources with which to make poor dietary decisions. Exploiting longitudinal data and exogenous variation to

address more rigorously the potential biases arising from non-random selection into the program, we found that any SNAP-induced increases to BMI are negligible under minimum benefit levels and nonexistent under maximum benefit levels. The results of this study suggest that recently proposed SNAP budget cuts and related reforms are unlikely to reduce obesity among participants. If anything, our results point to SNAP benefit increases as a means to addressing the SNAP-obesity link. Research suggests that both participants (86%) and non-participants (75%) support additional benefits for SNAP recipients (Franckle et al., 2019). Thus, despite recent calls for SNAP spending retrenchment, such a policy prescription may constitute a politically feasible means by which to bring about population health improvements.

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Declarations of competing interest

None.

CRediT authorship contribution statement

Megan M. Reynolds: Funding acquisition, Project administration, Investigation, Data curation, Conceptualization, Methodology, Software, Formal analysis, Visualization, Writing - original draft. **Ashley M. Fox:** Investigation, Data curation, Conceptualization, Methodology, Writing - original draft, Writing - review & editing. **Ming Wen:** Funding acquisition, Conceptualization, Writing - review & editing. **Michael W. Varner:** Funding acquisition, Conceptualization, Writing - review & editing.

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