The Impact of Childhood Nutrition Assistance on Child Health and Well-Being: Lessons from WIC *

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Abstract:

The Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) is one of the most widely used food assistance programs in the U.S. On a cohort basis, nearly half of infants participate in the program. WIC is aimed at ensuring that low-income children and pregnant women have access to healthful food. Previous research provides evidence about the causal impacts of WIC on birth outcomes, but evidence about impacts on child outcomes remains limited. In this paper, we use a regression discontinuity approach to estimate the causal effects of WIC on child health and nutritional outcomes. We estimate regression discontinuity models that leverage sharp changes in program benefits and eligibility in order to examine effects of the program on a wide range of health and nutrition outcomes including self-reported food and nutrient consumption (from food diaries), objective health measures from biomarker data (blood and urine draws, height and weight) and the incidence and type of hospital visits. Our research focuses on previously understudied questions such as the effects of WIC on infants and children; on spillover effects from targeted children to other family members who are not directly eligible for the programs; and on the effects of changes in the composition and delivery of program benefits.

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PRELIMINARY AND INCOMPLETE. PLEASE DO NOT CITE.

1. Introduction

The Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) is one of the most widely used food assistance programs and is aimed at ensuring that low-income pregnant and postpartum women, infants and children under age five have access to healthful food. WIC is a "quantity voucher" program that can be used to purchase a set quantity of infant formula and other specific food items such as milk, cereal and juice as specified in the WIC bundle by eligible groups with income below 185 percent of the poverty guideline. In fiscal year 2016, the program served 7.7 million at a cost of $6 billion.

In this paper, we estimate the effect of WIC on children's health and nutrition. Our work makes several contributions to the literature. First, most of the research on the WIC programs focuses on the effect of the program on birth outcomes,[1] yet pregnant women account for less than a quarter of WIC participants[2]. We analyze the effects on infants and children, who represent three quarters of the WIC population. Second, despite a great deal of previous research, finding empirical strategies that yield causal estimates is difficult given it is a national program and earlier attempts to use policy as instruments failed (e.g., Bitler and Currie, 2005). Early studies use comparisons between participants and non-participants to estimate the effect of food and nutrition programs. Many researchers (Currie, 2003; Bitler and Currie, 2005) have drawn attention to the fact that selection into participation in the WIC program is non-random, casting doubt on such comparison studies. Causal evidence about WIC is limited to a few

[1] Causal studies show consistent evidence that WIC leads to improvements in outcomes such as average birth weight, the incidence of low birth weight, and maternal weight gain (see review by Hoynes and Schanzenbach, 2015).

[2] In fiscal year 2016, the WIC program served 1.8 million women, 1.9 million infants and almost 4 million children ages 1-4.

studies, either applying to the period when the program rolled out (when hunger and anemia were more common and type 2 diabetes and obesity less of an issue) or applying to specific states or time periods. Our approach leverages sharp changes in program benefits and eligibility to identify estimates of the causal effects of WIC on infant and child outcomes. Thus, our work has the potential to update this literature with nationally representative estimates for a recent period. Third, we use multiple data sets to examine a wide range of health and nutrition outcomes, including self-reported food and nutrient consumption (from food diaries), objective health measures from biomarker data (blood and urine draws, height and weight) and the incidence and type of hospital visits.

One striking change in WIC benefits occurs at age one, when the composition of the bundle of foods and value of the foods to families provided by WIC changes radically. Specifically, at age 1, the child package adds solid foods but removes formula (which is highly valuable to participants). Whether this improves or harms health depends on whether the bundle of foods offered for younger children is more appropriate than that for the under 1-year olds and/or whether the benefits for one year olds and slightly older children are perceived to be more valuable to parents than benefits for younger children. Additionally, as we show, participation in WIC declines at age 1, when the benefit package shifts and there may be other program changes driving participation decreases. Our study helps to determine the effects of this change. Children age out of the WIC program entirely when they turn five years old, and we hypothesize that when children age out of the program, their nutrition and health will decline, as will that of any family members who also benefited from the WIC package of foods. In our paper, we will in the future also examine the impact of changes in the WIC food packages (the packages were changed in 2009 after being primarily fixed since 1992) and in the method of benefit distribution (the transition to electronic benefit transfer cards) on child health.[3]

While WIC is means tested and aimed at improving nutrition for the children most at risk of poor nutrition, it is important to note that this is a very widely used program, with huge potential to improve population health as well as health equity. WIC covers 53% of infants at birth and about 10% of children are still in the program right before their 5th birthdays.[4] Learning more about the program's health benefits, and importantly, whether health and diet quality decline after children lose access to those benefits or the benefit package becomes less attractive, will provide important information to improve population health and health equity.

Our empirical approach uses a regression discontinuity (RD) model, taking advantage of the sharp changes in eligibility and benefits at age 1 and age 5. In essence, our RD provides estimates from comparison of outcomes for children at ages just younger than the sharp changes in the program benefits and eligibility to those for children just older than the relevant age thresholds, considering children near ages 1 and 5 as the two relevant thresholds. If WIC eligibility is the only thing changing discontinuously at the age 5 threshold, this will uncover the causal effect of WIC at that age. The 12-month threshold captures both changes in program generosity and possible changes in other programs conferring eligibility but again, comparisons will capture the causal effects of the combined generosity and other programs changing.

As a first step, we estimate the first stage effects of WIC on these ages using data from

[3] These policies vary at the state and county level and require access to data with geographic detail. We have been recently approved to use the restricted version of NHANES which has these identifiers and will be included in the next version of the paper.

[4] https://www.fns.usda.gov/wic/about-wic-wic-glance and authors' calculations using the Survey of Income and Program Participation. Also see Hoynes and Schanzenbach (2015).

the Survey of Income and Program Participation (SIPP). We document that WIC participation changes discontinuously and sharply at 5 years, with a smaller insignificant change at 12 months. We also show that the use of other social safety net programs is smooth through the regression discontinuity. Second, we use data from the National Health and Nutrition Examination Survey (NHANES) to examine impacts on diet (including nutrients and foods), objectively measured biomarkers measured in blood/urine and elsewhere (e.g., height and weight), and other health outcomes. Third, we utilize data from the Healthcare Cost and Utilization Project (HCUP) which provides administrative hospital data covering inpatient hospital discharges (and in a subsequent draft also emergency room visits). Using these data, we examine how WIC impacts the probability of age-eligible children having hospital visits and specifically visits related to nutrition and digestive conditions. Both these data sources identify the age of children in months, allowing us to implement the regression discontinuity design. We examine specification tests typically associated with RD designs, such as the smoothness of the distribution of children on either side of the eligibility thresholds and smoothness of mean demographics across the thresholds, finding no impact of manipulation.

In future versions of the paper, we will explore spillover effects from targeted children to other family members who are not directly eligible for the programs. We also will be estimating difference-in-differences models to estimate the effects of changes in the composition (though changes in the WIC package in 2009) and delivery of program benefits (through the transition to EBT cards).[5]

[5] This too is an outcome that can only be studied in the restricted use NHANES data which we have not yet begun to use (but are approved to use).

The rest of the paper is organized as follows. In the next section we provide more background on the WIC program and summarize the prior literature on the program. In Section 3 we describe our data and in section 4 we describe our empirical approach. Section 5 provides our results. In section 6 we conclude.

2. The WIC Program and Prior Literature

The WIC program provides food vouchers covering set amounts of foods containing micronutrients such as iron, potassium, and others as well as nutritional education and referrals to other social assistance programs. Eligibility for WIC requires satisfying categorical eligibility and income eligibility rules and being at nutritional risk. Five types of individuals are categorically eligible for WIC: pregnant women, post-partum women for six months after birth, breastfeeding women with an infant under 12 months, infants (birth to just under 12 months), and children aged at least 1 but under age five. A different bundle of food is assigned separately for each group (with some other variation for children aged at least 1 but less than 2 and other children). Income eligibility requires that participants must have income under 185% of the Federal Poverty Guideline or be participating in a program conferring automatic eligibility such as AFDC/TANF, SNAP, or Medicaid. Unlike most other elements of the low-income social safety net, immigrants are eligible for WIC under the same circumstances as natives.[6]

WIC benefits differ from SNAP, the largest of the USDA food and nutrition programs, in a few important ways. First, the WIC benefit does not vary with countable income; there is no “benefit reduction rate” that marginally reduces the benefit as countable income. Instead (like

[6] States have the option to exclude non-citizens, only Indiana has done so.

Medicaid) there is a “cliff” or notch in the budget set; and recipients who are income and categorically eligible and at nutritional risk receive the full WIC package set of vouchers. Second, participants receive paper vouchers, or now, in many states, electronic benefit – EBT – cards-covering the purchase of specific types/amounts of foods, including infant formula for non-breastfeeding infants. Table 1 shows the current WIC food bundles. Children ages one to four, for example, receive vouchers for specific quantities of milk, juice, breakfast cereal, eggs, whole wheat bread, and legumes or peanut butter. (In some states, children at least 1 and under 2 have different choices for the level of fat in milk.) Starting in 2009, WIC has also included a cash value voucher for those ages 1-4 for fresh, frozen, or canned fruits and vegetables (initially set at $8 per month for a child 1-4). Thus, aside from this modest cash value voucher, WIC is a “quantity” voucher program.[7] Third, the foods provided by WIC are very specific. For example, allowable breakfast cereals must be low in sugar and fortified with iron, and juice must be 100% unsweetened fruit and/or vegetable juice. For that reason, we will distinguish between WIC eligible and non-WIC eligible cereal and juice in our analysis.

In addition to the vouchers/EBT cards entitling recipients to food, the program offers participants nutritional education and referrals to other services. Unlike some other nutrition assistance programs, WIC is run by local grantees with considerable discretion about the program offerings for nutritional education or breastfeeding promotion. (Note that eligibility rules and benefit amounts are set nationally or at the state level.)

Most of the existing WIC literature focus on the effects on pregnant women and birth

[7] Another difference from SNAP, WIC is not an entitlement, but there have not been waiting lists for the program recently.

outcomes. Many studies estimate the impact of the program by comparing WIC participants to eligible non-participants. In order for these studies to be causal, they must rely on there being no selection into WIC, and many authors critique this approach due to concerns about selection (Currie, 2003; Bitler and Currie, 2005). Some successful quasi-experimental approaches have been used. Hoynes, Page, and Stevens (2011) leverage the roll out of WIC across counties in the 1970s, and find that WIC improves birth weight. Rossin-Slater (2013) finds positive effects of access to WIC on birth outcomes with a family fixed effect IV approach, relying on within-family variation in access to local WIC clinics in Texas. Another approach taken is to compare outcomes among more narrowly defined treatment and control groups (e.g., Joyce et al. 2005, 2008; and Figlio et al. 2009, Currie and Rajani, 2015) finding beneficial effects of WIC on birth outcomes. Kreider, Pepper, and Roy (2016) develop nonparametric bounds and find that WIC reduces unhealthy birth weights.

The effects of WIC on children's nutrition and health are less well understood than the effects on birth outcomes. Arteaga, Heflin, and Gable (2016) use a regression discontinuity (RD) strategy and the Early Childhood Longitudinal Study, Birth Cohort (ECLS-B) data to look at effects of losing WIC eligibility on household food insecurity. They find that food insecurity increases when children lose WIC eligibility. Si and Leonard (2017) use data from Dallas and an RD and find that aging out of WIC leads to an increase in using a local food bank. We also use an RD strategy, an empirical approach with strong internal validity. We build on Arteaga, Heflin, and Gable (2016) and Si and Leonard (2017) in several ways. First, we look at a wide range of health and nutrition, including self-reported food consumption (from diaries) as well as nutrient consumption (from the same source). Additionally, we look at objective health measures from biomarker data (blood and urine draws, height and weight) from the NHANES and hospital admissions data from the HCUP. Secondly, we pool many years of NHANES and HCUP data, which span various ages, cohorts, and time periods, while the ECLS-B follows a single cohort across time. Finally, in the future, we will explore the effects of program changes which these authors do not consider.

Though WIC benefits are extended to specific family members (e.g., pregnant and post-partum women, children under 5), we will also examine possible spillovers to other household members. For instance, do the milk vouchers for the children 1-4 lead to more consumption of milk by other family members? Do parents of WIC children eat plain Cheerios purchased with WIC benefits while children eat other cereals? This speaks to the effectiveness of the targeting of WIC benefits and the children they are intended to reach. Along these lines, Martin-Anderson (2014) finds that adult men residing in WIC households consume more WIC eligible foods than those in similar non-WIC households. Using the household roster and exact ages of household members in the NHANES data once we obtain access to the restricted use data, we will investigate how one household member being eligible to get WIC benefits impacts other household members' diet and health.

Finally, we investigate whether changes to the composition of the food package – which began in 2009 after being largely fixed before then – and changes to the delivery of benefits from an identifiable voucher to an EBT card that looks and works much like a typical bank debit card - further improve health and change dietary patterns.[8] The WIC food package changes

[8] Hanks et al. (2017) study the effects of EBT on program takeup in several states (finding no significant changes) and also look at redemptions using store expenditure data, where they find an increase in redemptions after rollout. EBT WIC likely reduces stigma, but also allows families to redeem part of a

were meant to improve the nutritional content of covered foods. For example, a fruit and vegetable cash value voucher was added and the formulation of the quantity voucher was altered (e.g., except for the youngest groups, whole milk was replaced with lower fat versions). Frisvold and Price (2016) find that changes in the package led to changes in food purchasing decisions using scanner data. We expect that these improvements and expansions of the WIC package will also be reflected in improved nutrition and health. Similarly, we expect that as EBT cards are phased in, making it easier to use benefits and potentially reducing the stigma associated with using them, nutrition and health will be further improved.

3. Data and Outcomes of Interest

We estimate the RD models for a number of health and nutrition-related outcomes. Our analysis utilizes three datasets, each allowing us to examine a different set of outcomes.[9]

The Survey of Income and Program Participation: *First Stage*

To evaluate the first stage effects on WIC participation as well as (as placebos) participation in other social safety net programs, we use data from the Survey of Income and Program Participation (SIPP). While surveys are known to underreport program receipt, the SIPP captures more compete reporting than other surveys (Mok, Meyer and Sullivan 2009).

The SIPP is a nationally-representative household survey that includes information on

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month's worth of a specific food type while the pre-existing vouchers required that you can only redeem the full quantity of various items at one time (e.g., you would need to buy all the milk at once, or at a minimum, could not save some of the milk for a later date). Thus, EBT could have reduced the transactions cost in an additional way separate from any stigma effects.

[9] In a future version of the paper we plan to expand to include analyses based on the Nielsen Consumer Panel dataset (HomeScan). The HomeScan data contains food (and other) purchase information for a representative panel of households.

household income and participation in means-tested programs. While each respondent is interviewed over a period of approximately four years, we analyze the SIPP as a repeated cross-section here without incorporating the longitudinal nature of the data. Each interview covers four consecutive reference months; response errors are a particular concern in reference months other than the survey month (Kalton, et al., 1990). Therefore, we restrict the sample to months in which the survey month aligns with the reference month. We use data from the 2001, 2004, and 2008 SIPP panels, covering years 2000-2013.

In order to identify a population that is more likely to be affected by WIC, our main estimation sample is limited individuals who live in families with monthly income less than 200% of the federal poverty line (recall that the WIC income eligibility threshold is 185% of the FPL). We examine a higher income group (200-400% FPL) in part as a placebo analysis[10]. We also estimate results for other intent-to-treat subsamples with high WIC participation rates including children who live in a household with a single mother, low-SES subsamples defined by race and ethnicity (Black; Hispanic), and individuals in households where the *youngest* child is near the relevant age threshold. We expect that individuals living in households that lose access to WIC entirely (e.g., the household's youngest child is near the cutoff) will be more affected than individuals living in households that experience a reduction in benefits at age 1.

Overall, our SIPP sample included 2,000-6,600 children each year for the 12 month RD sample (ages 1-24 months) and 2,200-14,000 children per year in the 60 month RD sample

[10] Note that family income is measured for the same time period defining initial WIC eligibility or participation in programs conferring automatic eligibility. Additionally, families may have their incomes increase without losing their WIC status until they reach a recertification threshold. Thus, some may be in the 200 plus income to poverty range but still legitimately be on WIC or eligible for it. In practice this is relatively rare.

(ages 37-84 months) including all those with family income below 400 percent of the poverty line. Slightly more than 60 percent of these children are included in our main sample of households with income below 200 percent of the federal poverty line. Important for this analysis, the SIPP provides information on each individual's month of birth and the reference month, we calculate children's age in months as (surveymonth – birthmonth + 1).

The SIPP includes information on whether each person in a household is part of the WIC assistance unit (e.g., a pregnant mother or a child 60 months and younger). We use this information to measure own WIC participation[11]; household WIC participation is measured as whether any individual in the household is part of a WIC unit. Household participation in TANF, SNAP, Social Security, SSI, and UI are created analogously. Household receipt of subsidized housing is calculated as whether the household resides in public housing or receives government subsidized rent, including Section 8. Receipt of subsidized utilities is measured as whether the household receives subsidies for energy or utilities in the reference month.[12]

<u>The National Health and Nutrition Examination Survey: *Diet, Biomarkers and Health*</u>

The NHANES is designed to assess the health and nutritional status of adults and children in the U.S. It is unique in that it combines interviews and physical examinations while most other health surveys rely on self-reports. We use the data from NHANES III (1988-1994) and the continuous NHANES (providing annual data beginning in 1999). The continuous NHANES includes a nationally representative sample of about 5,000 persons each year. The NHANES III included a total of about 40,000 persons spanning the 6-year period. The survey is a

[11] Specifically, children older than 5 years (60 months) are not asked about WIC participation. Therefore, in the first stage figures below, participation falls to 0 (though it is not known if it is a true zero).

[12] Results are generally robust to defining children's age as (surveymonth – birthmonth).

geographic cluster design, concentrating in a subset of counties each year.

The interview component of the NHANES contains information on demographics, socioeconomic status, diet, and health. These measures include food insecurity, subjective health measures, and participation in social safety net programs. The survey also includes food diaries, providing detailed information for individual family members. Critically, in the public use NHANES data we observe child's age in months.[13] The examination component of the NHANES consists of medical, dental, and physiological measurements (e.g., height and weight), as well as laboratory tests administered by highly trained medical personnel based on blood and urine draws.

We pool many waves of NHANES data spanning the years 1988-2014. This pooled NHANES sample includes as many as 9,104 children between 0 and 24 months and 10,197 children between 37 and 84 months (for the full sample of children in those age ranges). As with the SIPP, our main estimation sample is children who live in families with monthly income less than 200% of the federal poverty line. We consider the same additional samples as the SIPP including children who live in a household with a single mother, black children, individuals in households where the *youngest* child is near the relevant age threshold and a higher income

[13] The public use NHANES allows us to conduct the RD analysis using age of child in months as the running variable. In future versions of the paper, we will use the restricted-use version of the data that will improve our estimates and expand the scope of our analysis in the following ways: 1) We will be able to replace "age in months" with "age in days", which will improve the precision of our WIC RD results. 2) We will be able to include the NHANES outcomes in our WIC differences-in-differences analysis of EBT rollout changes to the WIC packages (the necessary restricted use variables for this analysis are the county and state geocodes). 3) We will be able to conduct the spillover portion of the WIC RD analysis (the necessary restricted use variable for this analysis is the roster of birthdates of household members). We have recently been approved to access the restricted use NHANES for this project.

group (200-400% FPL) as a placebo analysis. As with the SIPP, we calculate children's age in months as (surveymonth – birthmonth + 1) (in a future draft we will be able to measure age in days).

Healthcare Cost and Utilization Project: *Hospital Discharge Data*

The Healthcare Cost and Utilization Project (HCUP) is sponsored by the Agency for Healthcare Research and Quality and provides the universe of general hospital administrative data for participating states. Here, we use the HCUP State Inpatient Databases (SID), which contains the universe of inpatient discharge records from participating states. The data include all diagnoses[14] and procedures, admission and discharge status, patient demographics (e.g., sex, age, and, for some states, race), and a consistent across state expected payment source (e.g., Medicaid, Medicare, private insurance, charity care, self-pay, and other).

We limit our analysis to the state x years that include the information necessary to calculate child's age in months at admission. For about 85-90% of the individuals that make up our HCUP sample, the data includes age in months. For the remaining 10-15%, we calculated it using admission month and birth month. Since we don't observe family income in this data, in our main analysis, we use the HCUP payer codes that are uniform across states and years and limit our sample to children whose visit is expected to be paid by for by Medicaid, as this provides a subpopulation in which we expect all children are eligible for WIC.[15]

[14] We are currently making use of the first nine diagnoses.

[15] We will expand the sample to also include those records reporting the visit was paid for by self-pay, charity care, and some "other" payers (which in at least some states includes other public programs, including Champus and some state-funded public programs). We expect that that these individuals are likely to be at high risk to be eligible for WIC, and will confirm this based on looking at the correlation on coverage and WIC participation and income eligibility for WIC using the CPS ASEC.

We collapse the HCUP data to cells defined by county X year of admission X age in months X race/ethnicity X gender. This requires us to limit the sample to the states that report zip codes (for individual residence). In the end, after limiting to state-years where we can construct age in months and county of residence we end up with data for 13 states, each covering a subset of the years 1991-2013[16]. For each cell, we count the total number of admissions and, using the ICD-9 (diagnosis) codes, counts of the number of admissions for diagnoses that would result from poor nutrition such as failure to thrive, feeding problems, dehydration, diarrhea, and iron deficiency.[17] We combine these cell counts with SEER data on population estimates by year, county, age (in years), gender and race/ethnicity to form rates per 100,000 persons. We estimate models using rates as well as counts and log counts as the dependent variable and population and log population as an independent variable. We use these population counts as weights in the model estimation of the rate regressions.[18] For now, we present the version of the results that uses cell level counts as the dependent variable and population as an independent variable.

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[16] For example, in some state/years we can't calculate age in months and we lose FL entirely plus some observations in other states. States that are dropped due to not having zip code include AR, CA, MA and MD.

[17] We identify these diagnosis groups based on frequency and links to causes associated with nutrition. We make use of a tool developed by the Agency for Health Care and Policy Research, the Clinical Classifications for Health Policy Research (CCHPR), which groups diagnosis codes into meaningful categories. We identified CCHPR codes that might be associated with nutrition: Nutritional deficiencies (CCHPR 52), Other nutritional; endocrine; and metabolic disorders (CCHPR 58), Deficiency and other anemia (CCHPR 59) and Other gastrointestinal disorders (CCHPR 155). Next, we added Dehydration (a possible side effect of nutrition related illnesses) and additional categories that were used in Weiss et al. (2013): Postsurgical Nonabsorption, Nutritional Neglect, Protein-Calorie Malnutrition, and Weight Loss or Failure to Thrive. Some of these more specific categories overlap with the broader CCHPR categories.

[18] In future version of the paper, we will also use the HCUP State Emergency Department Database (SEDD).

4. Research Design

As described above, children encounter a number of sharp changes in eligibility for or generosity of WIC. For those eligible for WIC, the package of foods they receive changes dramatically when they turn one-year old (Table 1) , and they age out of benefits entirely at the end of the month in which they turn 5 years old. These sharp cutoffs in access to WIC allow us to utilize a regression discontinuity (RD) framework, where we compare outcomes for individuals who are on one side of the eligibility cutoff to those who are on the other side. Using aging out of WIC at 60 months (five years) as an example, we are comparing children who are still age-eligible to receive benefits but are close to aging out, to those who have just recently aged out, while smoothly controlling for age.

This identification strategy relies on two assumptions. First, there is no sorting on either side of the cutoff. That is, individuals are not able to manipulate whether they fall on one side of the discontinuity or the other. In our case, the variable that determines eligibility for WIC is age (e.g., in months or, once we obtain the restricted access NHANES data, days). Given the nature of this variable, it is unlikely that sorting will be a problem in our context (it is unlikely that parents will report ages which are not their children's own true ages). Still, we test whether this is the case by examining the smoothness of the density through the discontinuity.[19]

Second, individuals on either side of the cutoff must be the same, except for that fact

[19] In contrast, a regression discontinuity based on family income (leveraging the income eligibility cliff that occurs at 185% of federal poverty line) could be manipulated though behavioral changes to gain eligibility. Even then, Pei (2017) finds little evidence of such adjustments for Medicaid and SCHIP.

that those on one side are "treated" and those on the other are not. To test this, we examine the smoothness of both pre-treatment variables, such as gender, race, and other demographic characteristics as well as time varying potentially manipulatable characteristics such as income through the discontinuity. We also need to rule out that use of other food and nutrition programs, or other social safety net programs, change discontinuously at the cutoff. Using the SIPP, we examine whether participation in other social safety net programs (Supplemental Nutrition Assistance Program, Medicaid, TANF, SSI, etc) is smooth through the discontinuity. The smaller food and nutrition programs (Child and Adult Care Food Program, the Summer Food Service Program) are not measured in the SIPP (or NHANES). Instead, we examine robustness to excluding children who turn five near the beginning or end of the school year from our RD analysis, in order to make sure our results are not affected by changes in use of the school-based food and nutrition programs. To be clear, it is not a problem for our identification strategy if children are simultaneously enrolled in other feeding programs; it is only problematic if enrollment in those programs changes discontinuously at the cutoff. Additionally, It is possible that in some states, Medicaid eligibility thresholds change at age 1; we will check for smoothness in Medicaid participation and also examine the sensitivity to limiting to states and years where eligibility does not change at age 1.[20]

The simplest regression is of the form:

$$(1)\ \ Y_i = \beta_1 + \beta_2 CUT_i + \beta_3 Age_i + \beta_4 Age_i * CUT_i + \varepsilon_i$$

where Y_i is the outcome of interest for child *i* (near the relevant age) and Age_i gives the age of

[20] Some reauthorization windows for Medicaid may lead to families needing to be reauthorized for WIC and/or Medicaid.

the child in months. We estimate separate models for the 12-month change in benefits and the 60-month age-out of benefits. For the 12 month RD, CUT_i is an indicator variable equal to 1 if the child ages out of the infant packet (Age_i >12 months). For the 5 year RD, CUT_i is an indicator variable equal to 1 if the child ages completely out of the program (Age_i >60 months). In all cases, the coefficient of interest is β_2, which gives the discontinuity at the cutoff.[21] β_3 gives the slope of the line to the left of the cutoff, and $\beta_3 + \beta_4$ gives the slope of the line to the right of the cutoff. These two slope variables control for age trends in the dependent variable, allowing β_2 to identify the *discontinuous* change in the outcome at the cutoff.

For example, for the 5 year old RD, if the outcome variable is "grams of WIC-approved cereal consumed," β_3 controls for the *age trend* in cereal consumption prior to turning five years old, $\beta_3 + \beta_4$ controls for the *age trend* in consumption after turning five years old, and β_2 gives the (discontinuous) effect of aging out of WIC on WIC-approved cereal consumption. It is important to note that our estimate of WIC (for the 5 year RD) is identified off of changes among those children who remained on WIC until their fifth birthday. Additionally, the effects of transitioning off the program at age 1 is limited to those on the program at that age and combines impacts for those leaving because WIC is no longer sufficiently attractive and impacts for those staying on the program who experience the change in the WIC food package.

All regressions are weighted using a triangular kernel and survey weights, and the standard errors are clustered by *Age* (in months). Our default bin size is 2 months, and the bandwidth is 12 months on either side of the discontinuity for the 12 month RD (the sample

[21] Once we have access to the restricted use data, our running variable will be *days* from the change in benefits (the last day of the month in which children turn 1 or 5).

includes children ages 1 to 24 months) and 24 months on either side for the 5 year RD (the sample includes children ages 37 to 84 months). We also plan to explore the robustness to using bin sizes/bandwidths and inference which going forward will be calculated using RD best practices (e.g., Calonico, Cattaneo, and Titiunik for bandwidths once we are using days, which is closer to continuous, and other adjustments for discrete running variables).

For regressions that utilize NHANES data, we will also confirm the robustness of our findings to adding state fixed effects and the statistical adjustments suggested by NHANES to adjust for the complex survey sample design as well as year or wave effects and individual and family covariates. For regressions that utilize the HCUP data, we collapse the data to cell level counts or the log of counts(described below); the RD model then includes fixed effects for the aggregate Xs which interact to create cells (so, if the cell varies by county/year/race-ethnicity/gender, the fixed effects will be county, year, race-ethnicity and gender). The estimates are also weighted using the population of the cell when looking at rates per capita, and when the cell measure is counts (e.g., Medicaid admissions), the population is a control on the right hand side.

Equation (1) is a version of RD where a linear regression line is fit to age on either side of the cutoff. We also estimate versions of RD that fit a higher-order polynomial to the data on either side of the cutoff. This will allow us to determine which specification better fits the data.[22] For example, the regression equation for a cubic is given by equation (2):

$$(2)\ Y_i = \beta_1 + \beta_2 CUT_i + \beta_3 Age_i + \beta_4 Age_i^2 + \beta_5 Age_i^3$$

[22] Gelman and Imbens (2014) raise questions about high order polynomials in RD, we will also explore alternatives.

$$+\beta_6 Age_i * CUT_i + \beta_7 Age_i^2 * CUT_i + \beta_8 Age_i^3 * CUT_i + \varepsilon_i$$

In all cases, β_2 remains the coefficient of interest, and the remaining betas are used to fit the curve to the left and right of the cutoff. We also note that we will use local linear methods, so the influence of far off measures is quite limited.

In future versions of the paper, we will use variation in state rollout of EBT benefits and the change in the WIC food package and a difference-in-differences model to examine effects of these changes on child health and nutrition. (As described below, conducting these analyses requires accessing a confidential version of the NHANES data. We have recently been granted access through the Census RDC network and will update with new results soon.)

Outcomes and Discussion of Expected Effects

Table 2 provides a summary of our outcomes of interest for our RD design. To guide our expected effects, we assign outcomes as primary if 1) they should be directly affected by the WIC program and 2) they are likely to change on a time frame that would allow them to be detected by the RD research design. We assign outcomes as exploratory if a theoretical link exists, but where data/power limitations or other information make us less likely to think we will observe a statistically significant relationship. With our DD design, which we will implement later, we expect to have a different set of exploratory and primary outcomes.

With our RD design, we expect some aspects of diet to change, particularly those food categories targeted directly by WIC and in high demand. For example, when infants turn 1, they are no longer able to get formula through WIC. Such a change in diet could result in an increase in emergency room visits for diarrhea if families end up making certain substitutions for formula. On the other hand, body measures such as height, weight or BMI are unlikely to change from one month to the next except in extreme circumstances. We assign consumption of popular WIC basket foods and nutrients tied to the following foods as primary; high demand WIC foods (based on redemption rates) include fruits and vegetables (from the cash value voucher during and after 2009), eggs, cheese, formula, juice, milk, and fish (based on the recent National Academies of Sciences, Engineering, and Medicine Review of the WIC Food Packages, all of these were redeemed at least 70% of the time). In addition to being in high demand, most of these foods are not durable and will go bad relatively quickly or are used nearly all the time (formula). We also will explore outcomes targeted by WIC nutritional education which are not associated with vouchers (e.g., fruit and vegetables pre-CVV), and once we gain access to the restricted NHANES, we will explore the impact of WIC EBT and the package changes on consumption of all of these foods and of micro and macro nutrients as primary outcomes for these DD analyses.

Similarly, we might expect to see changes in consumption of foods that are not directly targeted by WIC or WIC nutritional education (e.g., sugar-sweetened breakfast cereals or whole milk), if they are strong complements or substitutes for WIC targeted foods. When children age out of WIC, they might increase their consumption of sugar sweetened-cereals when WIC-subsidized low sugar cereal is no longer available. They may also switch from WIC-subsidized low fat milk to whole milk. Thus, we also classify some of these potentially indirectly affected foods as primary. However, some WIC targeted foods such as infant meats are very unpopular (the Academies report shows redemption of these foods is low at 31%.) We do not expect that when families age out of WIC or in the case of infant meats, turn 1 year old, they will change their consumption of these much.

Additionally, we identify the biomarkers measured in NHANES that are expected to adjust quickly as primary; these include transferrin saturation or ferritin measured in the blood (associated with anemia). Others such as vitamin A adjust more slowly and are identified as exploratory outcomes for the RD analyses.

5. Results

Summary Statistics

The summary statistics are in Table 3 for the SIPP, Table 4 for NHANES[23] and Table 5 for the HCUP. Table 3 shows that WIC participation among 1-24 month olds is high, with 42% receiving WIC. WIC use is still high among those 37-84 months, with 12% of children participating in WIC.[24] Table 4 shows that demographic outcomes are fairly similar for the 1-24 and 37-84 month samples. Not surprisingly, the older sample is much more likely to not be an only child, to consume higher amounts of soft drinks, cereals. The older group is less likely to suffer from inadequate zinc, and low protein. Table 4 presents the means from HCUP. Admissions are relatively rate, occurring for 228/100,000 children aged 1-24 months, and 48/100,000 aged 37-84 months.[25] Nutritional diagnoses are a relatively large subset of overall

[23] Table 3 and 5 include all children; ultimately in our regressions we limit the sample to those with income below 200% of the FPL.

[24] In Table 4, in the NHANES data, the WIC Self variable is created with data from 2007-2010. In these waves, the questions used to create the variable were asked until children were 71 months old, while in all other waves, the question was not asked for children older than 60 months. The WIC Household (WIC HH) variable is only available in the NHANES III (1988-1994).

[25] The denominator for our rates comes from SEER. These do not vary by month or by insurance status, but our main specification includes month of admission for the HCUP analysis and only includes patients for whom the primary payer is Medicaid. So, while computing rates gives some information about admission rates, and allows for more comparable comparisons between age groups, the "true" rates

diagnoses, at 46/100,000 for those 1-24 months, and 10/100,000 for those 37-84 months. This variable is equal to one if any of the diagnoses falls into one of the categories described in earlier in the section, even the less common ones that are not listed separately in the table. The vast bulk of visits are not-prescheduled for either age group. We also consider some important categories such as failure to thrive and dehydration.

First Stage: Effects of Age Out on WIC Participation

We start by reporting the first stage, of WIC participation, using the SIPP. We use the SIPP for the first stage, rather than the NHANES for three reasons.[26] First, it provides a significantly larger sample size than the NHANES. Second, we will also use the SIPP to test whether participation in other social safety net programs changes discontinuously at the WIC thresholds. Very few of those programs are observable in the NHANES. Third, the SIPP allows us to observe WIC participation at the household level, which is only possible in the earliest NHANES waves. One limitation of looking at the first stage, both in the SIPP and in most NHANES waves, is that the question isn't asked of children over the age of five. So, while these estimates give us a good picture of the number of children who are receiving WIC in the months leading up to their fifth birthday, the share drops to zero right at 60 months, by construction. That said, personal communication with WIC program personnel indicates that the program would face administrative challenges with ending benefits the day children turned 5 unless the

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would need to be scaled up by roughly 12 (to account for a full year of age) and by the percentage of non-Medicaid funded admissions.

[26] The comparable analysis using NHANES data can be found in Appendix Tables A1 and A2 and Figures A1 and A2. The WIC Self variable is created with data from 2007-2010. In these waves, the questions used to create the variable were asked until children were 71 months old, while in all other waves, the question was not asked for children older than 60 months. The WIC Household variable is only available in the NHANES III (1988-1994).

day for benefit disbursal is the same as the birthday. But providers would face strong incentives to not provide vouchers beyond the month in which children turn 5 years old.

The visual representation of the regression results, for the sample of children in families with income below 200% of the federal poverty line, are in Figure 1. Figure 1a provides plots for the age 5 RD and Figure 1b provides plots for the 12 month RD. In each figure, the first row displays the changes in child WIC receipt using the linear control for age (left graph) and cubic control for age (right graph). The second row provides similar plots for household WIC participation. Each dot on the figure represents the weighted share of children (or households), in 2-month bins, that report receiving WIC and the bars give the 95% confidence interval for the mean.

The distance between the fitted lines at 60 months (Figure 1a) and 12 months (Figure 1b) corresponds to the estimate of β_2. The estimate for the first stage (β_2) for this main sample as well as other subsamples is in Tables 6a and 6b.

Figure 1a shows a substantial and sharp reduction in child WIC participation at age 60 months – the estimates show a 23 percentage decline for the main sample of children living in households below 200% of the FPL for the linear control and a 16 percentage point decline for the cubic control. Table 6a also shows large estimates for subgroups with a high rate of WIC eligibility - black children and the sample of children in families with a single mother (14 and 16 percentage point declines for the cubic model, respectively). Encouragingly, the placebo sample of 200-400% of FPL has a much lower mean (0.045 vs 0.174 for less than 200% FPL) and experiences smaller declines in participation at 60 months. However, the non-zero means and statistically significant declines suggest that this group is not a perfect placebo sample[27]. The first stage results for this group suggest that we might expect the outcomes we examine in the main analysis to exhibit small changes due to WIC age out, even though the reported income is above the eligibility threshold. Columns 3 and 4 of Table 6a provides estimates for household participation in WIC (rather than the child themselves participating in the last month) showing much smaller first stages.

Table 6b and Figure 1b provide analogous estimates for the 12-month age-out of infant WIC benefits. Here the first stage is more muted; the estimates for the main sample (<200% FPL) show a 4 percentage point decline in WIC participation for the linear controls and small statistically insignificant changes for cubic controls. Of course, if there is no change in WIC participation at age 1, the RD would allow us to isolate the effect of the change in the benefit package that occurs at 12 months.

Returning to the RD graphs, the evidence in Figures 1a and 1b makes it evident that the cubic controls for age in months is a better fit to the data than the linear controls. We adopt the cubic controls as a preferred specification.

There are two additional points to make in examining this first stage. The first relates to the local average treatment effect nature of our estimates. About 25 percent of children in our main sample (<200% FPL) are still enrolled in WIC in the six months before they age out of eligibility. It is important to keep in mind that when we estimate our main health and nutrition outcomes, it is this sample of children who will be identifying the treatment effect. A much larger share of children– 63% in our main sample – are participating within six months of the

[27] See what we can learn about the quality of income reporting in the NHANES.

age-out of the 12 month infant WIC package. Our estimates of the 12-month RD will capture the combined effects of the participants who leave WIC when the child reaches 12 months as well as the change in the WIC package for the large share that remain on the program. Second, one might be concerned that the changes in nutrition and health outcomes at 12 or 60 months may be "normal" changes caused by typical developmental trajectories and that happen to show up discontinuously at ages 1 and 5. To address this concern, we estimate our models on the placebo sample between 200 and 400% of the FPL, who we show here have little access to WIC. If we then estimate discontinuities in our targeted eligible sample when children turn 1 or 5, but nothing in the placebo sample, this bolsters our faith that we are finding effects of WIC and not findings related to the normal developmental process for children of these ages.

Tests for RD Identifying Assumptions

To test for smoothness through the 12- and 60-month age-out points, Figure 2 presents estimates of the density in the NHANES sample by age in month bins. The figure shows that the sample is quite smooth across the age cutoffs, as we would expect. Neither cutoff shows any evidence of bunching.

We also test for smoothness in the pre-treatment characteristics through the age discontinuities. We use our NHANES sample and estimate equation (3) for demographic outcomes: dummy for the child being black, male, an only child, and where the household reference person has education less than high school. The graphic estimates are in Figure 3 (for 60 month) and 4 (for 12 month), and the parameter estimates are in Appendix Tables A3. There is little or no evidence of any discontinuities at either threshold, although the 12-month estimates are far noisier. Of 8 outcomes for the <200% FPL sample, only one of the 8 outcomes is statistically significant at the 5% level.

Finally, using SIPP data, we examine program participation in other social safety net programs to check whether there are simultaneous changes in other programs at 12 or 60 months. These estimates are provided in Table 7. While we examine a number of programs, we would be most concerned with changes in participation in Medicaid or SNAP. These programs are utilized by a large portion of households below 200% of the FPL, and the benefits they provide are most likely to directly affect our outcomes of interest. We find no evidence of a change in either of these programs at either age threshold (see columns 1 and 2 of Table 7 or Appendix Figure A3). More generally, for the 60 month RD, we find no statistically significant changes in program use. For the 12 month RD we find small and statistically significant increases in household receipt of subsidized housing, Social Security, and SSI.

<u>Main RD Estimates for Effect of WIC on Nutrition and Health, 60-month age-out</u>

We split the main results into four groups: food consumption (from the NHANES food diary), nutrients (from NHANES food diary and NHANES laboratory analysis), height and weight (from NHANES examination), and hospital admissions (from HCUP).

Figure 5 presents the results for the NHANES food diary (the parameter estimates are in Table 8). Each of the food diary items is expressed in grams and we classify the items into "WIC Basket" (e.g., cheese, eggs, low sugar/high iron cereal) and those not in the WIC basket (e.g., soda, sugary cereal).[28] Overall, we would expect that WIC basket foods should decline after 60

[28] We do not include produce in the WIC basket, as the cash value vouchers weren't introduced until late in our sample. In future drafts, we will look at produce separately before and after it was introduced.

months while non-WIC basket foods could go either way (depending on the income effect of losing WIC versus the substitution effect of non-WIC food prices falling relative to WIC goods). Somewhat surprisingly, there is little effect of losing access to WIC.

Figure 6 and Table 9 present the results for the NHANES nutrients including those for the presence of anemia (from a combination of laboratory tests) as well as for inadequate levels of zinc, calcium and protein (all from the food diaries). We define a child as anemic if they have hemoglobin<11.5 and hematocrit<35 (following guidelines). For zinc, calcium and protein we define dummy variables equal to 1 if the child is reported as consuming below the recommended daily allowance (e.g., <1000 mg of zinc per day). Since each of these are poor nutrient outcomes, we expect these to increase with the aging out of WIC. Again, we see little effect of ending age eligibility on nutrition outcomes for those nearing 5. While there is an increase in low-protein for those under 200% of poverty nearing age 5, there is a decrease in anemia.

Figure 7 and Table 10 show the results using the NHANES examination data on height and weight. These are measured using trained professionals in the NHANES "mobile examination centers." We use the measured height and weight to construct three binary measures: weight for age below 10^{th} percentile, weight for age above 90^{th} percentile, and height for age below the 10^{th} percentile using WHO calculations for percentiles of height and weight by age. In contrast to food consumption and nutrients, we would not expect that weight or particularly height for age to adjust from month to month. Yet, somewhat surprisingly, we see a decline in the probability that height is under the 10^{th} percentile and an increase in the probability that height is below the 10th percentile, though these are only statistically significant at the 10 percent level.

Finally, Figure 8 and Table 11 present the results based on the HCUP hospital admissions.[29] While we also conduct analyses on rates per 100,000 and log counts, the results presented in this version of the paper are based on cell level counts of admissions paid by Medicaid, with the population as a control variable.[30] Overall, we find little evidence of changes in hospital admissions at 60 months. There are statistically significant declines in scheduled admissions, in admissions related to "deficiency and other anemia" and in admissions related to "other gastrointestinal disorders."

One potential confounder for the HCUP analysis is changes in Medicaid eligibility or participation that occurs at the same point as the aging out of WIC. One source of potential age-discontinuities in Medicaid participation could be the underlying variation in how states' implemented the Medicaid expansions beginning in the late 1980s (e.g., see Gruber 1997). States expanded Medicaid by incrementally expanding up the income distribution and up the child age distribution – ultimately (pre-ACA) all states had to cover all children up to age 18 in families up to the poverty line. We (will) test for this confounder by limiting our sample to the states and years for which the Medicaid eligibility was smooth through the 60 month WIC

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[29] The models underlying Figure 8 and Table 11 do not include any control variables (population or fixed effects). Table A3 presents the results of the same regressions *with* controls for gender, year and race fixed effects. The estimates are almost exactly the same.

[30] As noted above we collapse the HCUP data to cells based on county, year, age, gender and race/ethnicity in order to match to SEER population estimates for these same cells. The population counts are not a perfect match given that the numerator counts Medicaid funded admissions within each of these cells. We are investigating alternative formulations to provide a better match between the counts of admission and the at risk population.

discontinuity. We do not expect this to be a big factor as, in practice, there are few states for whom Medicaid eligibility varies for those age 4 versus 5. We also plan to expand the count of admissions to include not only Medicaid but also charity care, self-pay and a subset of the "other" category.

Main RD Estimates for Effect of WIC on Nutrition and Health, 12-month age-out

Again, we split the main results into four groups: food consumption (from the NHANES food diary), nutrients (from the NHANES food diary and NHANES laboratory analysis), recumbent length[31] (from NHANES examinations), and hospital admissions (from HCUP analysis). Given the lack of a first stage change in participation for the 12 month RD, these should be capturing the changes in the WIC package.

Starting with the food diary analysis (Figure 9, estimates in Appendix Table A6) we expect that formula and infant WIC basket foods should decline after 12 months while other WIC basket foods could go either way: For families leaving WIC at 12 months, there could be a decline in WIC foods, while those staying on the program might obtain more of foods not in the infant package. For our main sample, we see very few changes at this threshold. There is a statistically significant decrease in WIC eligible juice, but the figure suggests that this is caused by a bad fit in the age polynomial.

Figure 10 presents the results for the NHANES nutrients including those for inadequate levels of zinc, calcium and protein (estimates in Appendix Table A7). (We cannot look at anemia for the infants). For zinc, calcium and protein we define dummy variables equal to 1 if the child is reported as consuming below the recommended daily allowance (e.g., <1000 mg of zinc per

[31] Recumbent length is used to measure infants and children less than two years of age.

day). Corresponding to the change in milk, we see an increase in having too little calcium at 12 months.

Figure 11 shows the results using the NHANES examination data on recumbent length being less than the 5th or 10th percentiles (estimates in Appendix Table A8). We would not expect recumbent length to respond to changes in WIC on a monthly basis; though below 5th percentile increases significantly at the discontinuity.

Overall, the NHANES results for the 12 month RD are fairly noisy and the findings are sensitive to the specification for the control variables (not shown here). At this point, we cannot conclude much from the NHANES analysis for 12 month RD, and we hope that our fit will improve when we have age in days and can (hopefully) use a tighter bandwidth. Right now, the results are quite sensitive to the specification, and both linear and cubic fit poorly, just in different ways.

Finally, Figure 12 and Table 12 present the results based on the HCUP hospital admissions.[32] Recall that these are counts of admissions paid by Medicaid with total population on the right hand side.[33] We find that a number of the categories show an increase in admissions but none are statistically significant. The small (and statistically insignificant) increase in the overall rate of admissions seems to be driven by an increase in unscheduled (vs.

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[32] In order to make the figures straight forward, Figure 12 and Table 12 do not include any control variables (population or fixed effects). Table A9 presents the results of the same regressions *with* the control variables. The estimates are almost exactly the same.

[33] As noted above we collapse the HCUP data to cells based on county, year, age, gender and race/ethnicity in order to match to SEER population estimates for these same cells. The population counts are not a perfect match given that the numerator counts Medicaid funded admissions within each of these cells. We are investigating alternative formulations to provide a better match between the counts of admission and the at risk population.

scheduled) visits and a small but statistically insignificant increase in any nutritional related diagnoses. Overall, there is little evidence that changes in WIC at age 1 are having important effects in reducing admissions.

One potential confounder for the HCUP analysis is changes in Medicaid eligibility or participation that occurs at the same point as the aging out of WIC. States expanded Medicaid by incrementally expanding up the income distribution and up the child age distribution – ultimately (pre-ACA) all states had to cover all children up to age 18 in families up to the poverty line. Typically, income eligibility becomes less generous at 1 year, so this would operate in the opposite direction of the increase in admissions at age 1. Nonetheless, we will test for this confounder by limiting our sample to the states and years for which the Medicaid eligibility was smooth through the 12 month WIC discontinuity. We also plan to expand the count of admissions to include not only Medicaid but also charity care, self-pay and a subset of the other.

6. Conclusions

In this study, we provide the first comprehensive analysis using a regression discontinuity approach that leverages changes in the WIC program at age 12 months and 60 months. Critically, a child loses eligibility for WIC when they turn 5 years old, and the data shows that a large share of children remain eligible up until that point. We use data from the SIPP, the NHANES and the HCUP to examine impacts on social safety net participation (the first stage and ruling out confounders), food consumption, nutritional content and health, and hospital discharges related to nutritional causes. Overall we find a strong first stage at 60 months with no evidence of confounders. However, our results to date show little effect on health or nutritional outcomes. The 12 month discontinuity, where the WIC package changes but income eligibility remains constant, we find less evidence of a first stage allowing for possible isolation of the impact of the change in the WIC package. Those estimates are noisier, but also show little impact of the discontinuity on health or nutritional outcomes.

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Table 1 WIC Food Packages - Monthly

Food Package	Recipient	Food
I -- 0-5 Months	Infants, fully formula fed	WIC formula: 823 fl oz reconstituted liquid concentrate (0-3 months)
		WIC formula: 896 fl oz reconstituted liquid concentrate (4-5 months)
	Infants, partially breastfed	WIC formula: 104 fl oz reconstituted powder (0-1 month)
		WIC formula: 388 fl oz reconstituted liquid concentrate (1-3 months)
		WIC formula: 460 fl oz reconstituted liquid concentrate (4-5 months)
II -- 6-11 Months	Infants, fully formula fed	WIC formula: 630 fl oz reconstituted liquid concentrate
		Infant cereal: 24 oz
		Baby food fruits & vegetables: 128 oz
	Infants, partially breastfed	WIC formula: 315 fl oz reconstituted liquid concentrate
		Infant cereal: 24 oz
		Baby food fruits & vegetables: 128 oz
	Infants, fully breastfed	Infant cereal: 24 oz
		Baby food fruits & vegetables: 256 oz
		Baby food meat: 77.5 oz
IV -- 1-4 Years	Children:	Juice, single strength: 128 fl oz
		Milk: 16 qt*
		Breakfast cereal: 36 oz
		Eggs: 1 dozen
		Fruits & vegetables: $8.00 in cash value voucher
		Whole wheat bread: 2 lb**
		Legumes, 1 lb dry or 64 oz canned OR peanut butter, 18 oz
V	Pregnant and partially breastfeeding women (up to 1 year postpartum)	Juice, single strength: 144 fl oz
		Milk: 22 qt*
		Breakfast cereal: 36 oz
		Eggs: 1 dozen
		Fruits & vegetables: $10.00 in cash value voucher
		Whole wheat bread: 1 lb**
		Legumes, 1 lb dry or 64 oz canned AND peanut butter, 18 oz
VI	Postpartum women (not breastfeeding, up to 6 months postpartum)	Juice, single strength: 96 fl oz
		Milk: 16 qt*
		Breakfast cereal: 36 oz
		Eggs: 1 dozen
		Fruits & vegetables: $10.00 in cash value voucher
		Legumes, 1 lb dry or 64 oz canned OR peanut butter, 18 oz
VII	Fully breastfeeding women (up to 1 year postpartum)	Juice, single strength: 144 fl oz
		Milk: 24 qt*
		Breakfast cereal: 36 oz
		Cheese: 1 lb
		Eggs: 2 dozen
		Fruits & vegetables: $10.00 in cash value voucher
		Whole wheat bread: 1 lb**
		Fish, canned: 30 oz***
		Legumes, 1 lb dry or 64 oz canned AND peanut butter, 18 oz

* Allowable options for milk alternatives are cheese, soy beverage, tofu, and yogurt (partially). No whole milk for > 2 years. ** Allowable options for whole wheat bread are whole grain bread, brown rice, bulgur, oatmeal, whole-grain barley, soft corn, or whole wheat tortillas.
*** Allowable options for canned fish are light tuna, salmon, sardines, mackerel, and Jack mackerel. Source: USDA Federal Register/ Vol. 79, No. 42/March 2014/; Rules and Regulations accessed http://www.fns.usda.gov/sites/default/files/03-04-14_WIC-Food-Packages-Final-Rule.pdf

Table 2: Outcomes of Interest

Outcome	Likely Impact	Dataset
WIC participation	Primary	NHANES Questionnaire
Self-reported consumption, in WIC basket	Primary	NHANES Dietary Interview
Self-reported consumption, substitutes / complements to WIC basket	Primary	NHANES Dietary Interview
Self-reported nutrient intake, WIC targeted (e.g., iron)	Primary	NHANES Dietary Interview
Self-reported nutrient intake, not targeted pre-2009 package change (e.g., fiber)	Exploratory	NHANES Dietary Interview
Food insecurity	Primary	NHANES Questionnaire
Laboratory blood tests, adjusts quickly (e.g., ferritin)	Primary	NHANES Laboratory
Laboratory blood tests, adjusts slow (e.g., vitamins A, D)	Exploratory	NHANES Laboratory
Hospital visit, type / diagnosis	Exploratory	HCUP
Body measures (weight, BMI)	Exploratory	NHANES Examination

Table 3: SIPP Summary Statistics by Age at Medical Exam

	1-24 Months			37-84 Months		
	Mean	SD	N	Mean	SD	N
WIC Variables						
WIC Self	0.421	0.494	54203	0.124	0.329	130241
WIC HH	0.446	0.497	54203	0.233	0.423	130241
Other Program Participation						
TANF HH	0.059	0.236	54203	0.052	0.223	130241
Medicaid Self	0.442	0.497	54203	0.400	0.490	130241
Subsidized Housing HH	0.078	0.268	54203	0.086	0.280	130241
SNAP HH	0.270	0.444	54203	0.262	0.439	130241
Social Security HH	0.072	0.258	54203	0.089	0.284	130241
SSI HH	0.044	0.204	54203	0.046	0.210	130241
UI HH	0.044	0.205	54203	0.040	0.195	130241
Utility Assistance HH	0.089	0.284	54203	0.097	0.296	130241
Demographic Variables						
<200% FPL	0.613	0.487	54203	0.608	0.488	130241
200-400%FPL	0.387	0.487	54203	0.392	0.488	130241
Black	0.162	0.369	54203	0.181	0.385	130241
Only child	0.393	0.488	54203	0.387	0.487	130241
Single mother	0.279	0.449	54203	0.309	0.462	130241

Notes: This table gives the summary statistics for the Survey of Income and Program Participation (SIPP). Means are weighted using survey weights. The first set of columns gives the summary statistics for children close in age to the 12 month package change, while the second set of columns gives the summary statistics for children who are close in age to the 60 month age out of the WIC program.

Table 4: NHANES Summary Statistics by Age at Medical Exam

	1-24 Months			37-84 Months		
	Mean	SD	N	Mean	SD	N
WIC Variables						
WIC Self	0.445	0.497	1470	0.172	0.378	1192
WIC HH	0.340	0.474	3226	0.140	0.347	3784
Height, Weight and Length for Age						
Weight, <=10th p	.	.	.	0.068	0.252	10067
Weight, >=90th p	.	.	.	0.157	0.363	10067
Height, <=10th p	.	.	.	0.069	0.254	10096
Recum. Length, <=5th p	0.052	0.221	9003	.	.	.
Recum. Length, <=10th p	0.090	0.287	9003	.	.	.
Nutrients						
Anemia (Hemoglobin<11.5, Hematocrit<35)	.	.	.	0.061	0.240	7893
Low Zinc (Food Intake, <4 mg)	0.130	0.337	7299	0.081	0.273	9132
Low Calcium (Food Intake, <1000 mg)	0.682	0.466	7299	0.633	0.482	9132
Low Protein (Food Intake, <19 g)	0.237	0.425	7299	0.016	0.124	9132
Food Diary: WIC Basket						
Milk, grams	273.297	372.129	8755	276.480	274.985	9381
Cheese, grams	4.797	14.082	8755	9.266	19.836	9381
Egg, grams	3.832	16.261	8755	5.519	20.480	9381
Cereal, grams	16.216	52.888	8755	18.977	58.846	9381
Juice, grams	45.996	136.035	8755	75.456	156.493	9381
Beans, grams	3.929	20.066	8755	8.341	30.285	9381
Food Diary: Other Foods Categories						
Produce, grams	54.311	90.960	8755	105.852	138.022	9381
White Potato, grams	5.665	24.996	8755	8.462	35.719	9381
High Surgar Cereal, grams	2.462	8.209	8755	12.338	21.155	9381
Fruit Drink, grams	65.311	145.681	8755	55.495	145.438	9381
Soft Drink, grams	13.902	70.455	8755	104.648	188.279	9381
Demographic Variables						
Black	0.142	0.349	9104	0.151	0.358	10197
<200% FPL	0.528	0.499	8381	0.534	0.499	9432
200-400% FPL	0.283	0.450	8381	0.282	0.450	9432
Only Child	0.257	0.437	8495	0.128	0.334	9790
< HS (HH Ref Person)	0.224	0.417	8989	0.228	0.420	10121
Male (Child)	0.518	0.500	9104	0.515	0.500	10197

Notes: This table gives the summary statistics for the National Health and Nutrition Examination Survey (NHANES). Means are weighted using survey weights. The first set of columns gives the summary statistics for children close in age to the 12 month package change, while the second set of columns gives the summary statistics for children who are close in age to the 60 month age out of the WIC program.

Table 5: HCUP Summary Statistics by Age

	1-24 Months			37-84 Months		
	Mean	SD	N	Mean	SD	N
Rates: Medicaid Funded Patients per 100,000 Population						
Any Admission	228.047	384.555	617894	48.415	127.031	1235786
Any Nutrition Related DX	45.996	129.757	617894	9.663	59.633	1235786
Any Scheduled Visit	12.981	57.123	295146	3.763	23.273	589338
Any Unscheduled Visit	106.811	258.088	295146	21.471	64.864	589338
CCHPR 58: Oth. Nutr., Endoc., Metab. Dis.	13.463	60.856	617894	2.520	27.865	1235786
CCHPR 59: Deficiency and Other Anemia	9.505	49.151	617894	1.844	21.545	1235786
CCHPR 155: Oth. Gastrointestinal Disorders	12.800	61.755	617894	3.488	33.366	1235786
Dehydration	16.782	85.233	617894	3.200	39.824	1235786
Weight Loss, Failure to Thrive	7.548	47.559	617894	0.540	10.291	1235786
Counts of Medicaid Funded Patients by Cell (County× Year of Admit.× Age in Months× Race/Eth.× Gender)						
Any Admission	0.913	4.874	617894	0.195	1.020	1235786
Any Nutrition Related DX	0.184	0.952	617894	0.039	0.258	1235786
Any Scheduled Visit	0.057	0.476	295146	0.017	0.168	589338
Any Unscheduled Visit	0.468	3.217	295146	0.095	0.702	589338
CCHPR 58: Oth. Nutr., Endoc., Metab. Dis.	0.054	0.339	617894	0.010	0.112	1235786
CCHPR 59: Deficiency and Other Anemia	0.038	0.315	617894	0.007	0.097	1235786
CCHPR 155: Oth. Gastrointestinal Disorders	0.051	0.354	617894	0.014	0.137	1235786
Dehydration	0.067	0.451	617894	0.013	0.131	1235786
Weight Loss, Failure to Thrive	0.030	0.248	617894	0.002	0.049	1235786
Demographic Variables						
Population	400.403	1072.956	617894	403.471	1057.751	1235786
Black	0.301	0.459	617894	0.300	0.458	1235786
Hispanic	0.338	0.473	617894	0.338	0.473	1235786
Non Metroarea County	0.269	0.444	127254	0.183	0.387	109073
Year of Admission	2005.394	5.269	617894	2005.410	5.266	1235786

Notes: This table gives the summary statistics for the Healthcare Cost and Utilization Project (HCUP). The means of the rates in panel A are weighted by the cell's population, and the rest of the means are unweighted. The first set of columns gives the summary statistics for children close in age to the 12 month package change, while the second set of columns gives the summary statistics for children who are close in age to the 60 month age out of the WIC program.

Table 6a: 60 Month Age Out, WIC Participation, SIPP

	Self		Household	
	Linear	Cubic	Linear	Cubic
Full	-0.1643***	-0.1144***	-0.0592***	-0.0482***
	(0.0123)	(0.0054)	(0.0059)	(0.0063)
Mean	0.124	0.124	0.233	0.233
N	130241	130241	130241	130241
< 200% FPL	-0.2297***	-0.1574***	-0.0761***	-0.0632***
	(0.0190)	(0.0099)	(0.0098)	(0.0102)
Mean	0.174	0.174	0.329	0.329
N	80215	80215	80215	80215
200-400% FPL	-0.0606***	-0.0475***	-0.0268***	-0.0220**
	(0.0038)	(0.0048)	(0.0050)	(0.0089)
Mean	0.045	0.045	0.084	0.084
N	50026	50026	50026	50026
Black	-0.2019***	-0.1441***	-0.0750***	-0.0715***
	(0.0142)	(0.0101)	(0.0079)	(0.0127)
Mean	0.160	0.160	0.299	0.299
N	22224	22224	22224	22224
Only Child	-0.1348***	-0.1064***	-0.0914***	-0.0720***
	(0.0088)	(0.0082)	(0.0069)	(0.0050)
Mean	0.098	0.098	0.129	0.129
N	49152	49152	49152	49152
Single Mother	-0.2153***	-0.1556***	-0.0891***	-0.0820***
	(0.0153)	(0.0068)	(0.0107)	(0.0134)
Mean	0.162	0.162	0.296	0.296
N	40563	40563	40563	40563

Notes: Each cell presents the coefficient of interest (β_2) from estimating either the linear specification of the running variable in Equation (1) (columns 1 and 3) or the cubic specification of the running variable in Equation (2) (columns 2 and 4) for the subsample listed at the beginning of the row and the outcome listed at the top of the column. Standard errors (in parentheses) are clustered by age in months. Observations are weighted using SIPP sampling weights. * $p < .10$, ** $p < .05$, and *** $p < .01$.

Table 6b: 12 Month, WIC Participation, SIPP

	Self		Household	
	Linear	Cubic	Linear	Cubic
Full	-0.0214	0.0131	-0.0183	0.0165
	(0.0205)	(0.0167)	(0.0216)	(0.0182)
Mean	0.421	0.421	0.446	0.446
N	54203	54203	54203	54203
< 200% FPL	-0.0459**	-0.0068	-0.0420*	0.0024
	(0.0217)	(0.0200)	(0.0242)	(0.0234)
Mean	0.575	0.575	0.606	0.606
N	34094	34094	34094	34094
200-400% FPL	-0.0074	0.0203	-0.0067	0.0140
	(0.0102)	(0.0143)	(0.0105)	(0.0168)
Mean	0.179	0.179	0.192	0.192
N	20109	20109	20109	20109
Black	-0.0538	0.0274	-0.0530	0.0216
	(0.0365)	(0.0297)	(0.0338)	(0.0299)
Mean	0.593	0.593	0.630	0.630
N	8786	8786	8786	8786
Only Child	-0.0406***	-0.0532**	-0.0396**	-0.0706***
	(0.0157)	(0.0232)	(0.0162)	(0.0220)
Mean	0.420	0.420	0.439	0.439
N	21159	21159	21159	21159
Single Mother	-0.0353	0.0088	-0.0347	0.0099
	(0.0302)	(0.0181)	(0.0303)	(0.0182)
Mean	0.615	0.615	0.653	0.653
N	15471	15471	15471	15471

Notes: Each cell presents the coefficient of interest (β_2) from estimating either the linear specification of the running variable in Equation (1) (columns 1 and 3) or the cubic specification of the running variable in Equation (2) (columns 2 and 4) for the subsample listed at the beginning of the row and the outcome listed at the top of the column. Standard errors (in parentheses) are clustered by age in months. Observations are weighted using SIPP sampling weights. * $p < .10$, ** $p < .05$, and *** $p < .01$.

Table 7: Other Program Participation at 12 and 60 months

(a) 60 Months

	SNAP (HH)	Medicaid (Self)	TANF (HH)	Subsidized housing	Social Security (HH)	SSI (HH)	UI (HH)	Utilities or energy asst
< 200% FPL	0.0117	0.0112	0.0095	-0.0077	0.0065	-0.0040	-0.0025	-0.0004
	(0.0136)	(0.0101)	(0.0090)	(0.0107)	(0.0052)	(0.0036)	(0.0034)	(0.0093)
Mean	0.397	0.553	0.078	0.132	0.099	0.060	0.046	0.149
N	80215	80215	80215	80215	80215	80215	80215	80215

(b) 12 Months

	SNAP (HH)	Medicaid (Self)	TANF (HH)	Subsidized housing	Social Security (HH)	SSI (HH)	UI (HH)	Utilities or energy asst
< 200% FPL	0.0224	0.0068	0.0131	0.0367***	0.0285***	0.0333***	0.0012	0.0184*
	(0.0163)	(0.0139)	(0.0136)	(0.0122)	(0.0069)	(0.0049)	(0.0054)	(0.0102)
Mean	0.401	0.595	0.087	0.118	0.080	0.059	0.048	0.134
N	34094	34094	34094	34094	34094	34094	34094	34094

Notes: Each cell presents the coefficient of interest (β_2) from estimating the cubic specification of the running variable in Equation (2) for the subsample listed at the beginning of the row and the outcome listed at the top of the column. Standard errors (in parentheses) are clustered by age in months. Observations are weighted using SIPP sampling weights. * $p < .10$, ** $p < .05$, and *** $p < .01$.

Table 8: 60 Month Age Out, Food Diary / Consumption

	WIC Basket										
	(1) Milk	(2) Cheese	(3) Eggs	(4) Cereal	(5) Juice	(6) Beans	(7) Produce	(8) White Potato	(9) High Sug. Cereal	(10) Fruit Drink	(11) Soda
< 200% FPL	18.7221	-0.1704	-2.3316	-3.3849	10.7130	1.9242	7.7448	-2.4260	0.7947	8.1921	-8.8889
	(36.9607)	(2.2858)	(2.0758)	(4.9254)	(22.7056)	(3.0343)	(16.2985)	(4.1926)	(2.1182)	(8.4596)	(19.6768)
Mean	280.690	9.062	6.961	20.956	77.598	10.248	97.617	9.891	12.845	48.338	114.281
N	5811	5811	5811	5811	5811	5811	5811	5811	5811	5811	5811
200-400% FPL	37.4572	-0.1962	1.3434	-8.0457	-36.4996	-0.0574	-13.5072	8.7328	8.0452**	-49.3784*	24.2214
	(34.8311)	(2.2508)	(2.3889)	(5.4240)	(30.2870)	(2.1199)	(26.2832)	(7.1990)	(3.2623)	(26.1528)	(29.8337)
Mean	283.041	8.979	4.743	17.943	70.381	6.469	102.501	8.057	12.742	60.348	110.003
N	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999

Notes: Each cell presents the coefficient of interest (β_2) from estimating the cubic specification of the running variable in Equation (2) for the subsample listed at the beginning of the row and the outcome listed at the top of the column. Standard errors (in parentheses) are clustered by age in months. Observations are weighted using NHANES sampling weights. * $p < .10$, ** $p < .05$, and *** $p < .01$.

Table 9: 60 Month Age Out, Nutrients

	(1) Anemia	(2) Low Zinc	(3) Low Calc.	(4) Low Prot.
$<$ 200% FPL	-0.0454***	-0.0022	0.0016	0.0267***
	(0.0160)	(0.0249)	(0.0407)	(0.0076)
Mean	0.070	0.074	0.644	0.018
N	5121	5662	5662	5662

Notes: Each cell presents the coefficient of interest (β_2) from estimating the cubic specification of the running variable in Equation (2) for the subsample listed at the beginning of the row and the outcome listed at the top of the column. Standard errors (in parentheses) are clustered by age in months. Observations are weighted using NHANES sampling weights. * $p < .10$, ** $p < .05$, and *** $p < .01$.

Table 10: 60 Month Age Out, Body Measurements

	(1) Wt. <=10th p	(2) Wt. >=90th p	(3) Ht. <=10th p
< 200% FPL	-0.0303*	0.0148	0.0304*
	(0.0160)	(0.0461)	(0.0155)
Mean	0.075	0.167	0.078
N	6241	6241	6263

Notes: Each cell presents the coefficient of interest (β_2) from estimating the cubic specification of the running variable in Equation (2) for the subsample listed at the beginning of the row and the outcome listed at the top of the column. Standard errors (in parentheses) are clustered by age in months. Observations are weighted using NHANES sampling weights. * $p < .10$, ** $p < .05$, and *** $p < .01$.

Table 11: 60 Month Age Out, HCUP Medicaid Funded Admissions

	(1) Any Adm.	(2) Any Nut.	(3) Sched	(4) Unsched	(5) CCHPR 58	(6) CCHPR 59	(7) CCHPR 155	(8) Dehyd.	(9) WL, FTT
Medicaid Funded	0.0036	-0.0017	-0.0022**	0.0047	0.0003	-0.0010**	-0.0016**	0.0004	0.0003
	(0.0055)	(0.0013)	(0.0008)	(0.0042)	(0.0006)	(0.0004)	(0.0007)	(0.0005)	(0.0002)
Mean	0.195	0.039	0.017	0.095	0.010	0.007	0.014	0.013	0.002
N	1235786	1235786	589338	589338	1235786	1235786	1235786	1235786	1235786

Notes: Each cell presents the coefficient of interest (β_2) from estimating the cubic specification of the running variable in Equation (2) for cell level counts of the outcome listed at the top of the column for the sample of Medicaid funded admissions. Standard errors (in parentheses) are clustered by age in months. * $p < .10$, ** $p < .05$, and *** $p < .01$.

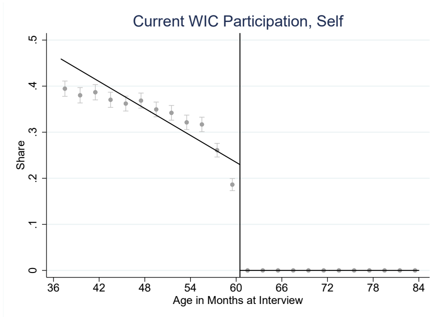
Table 12: 12 Month, HCUP Medicaid Funded Admissions

	(1) Any Adm.	(2) Any Nut.	(3) Sched	(4) Unsched	(5) CCHPR 58	(6) CCHPR 59	(7) CCHPR 155	(8) Dehyd.	(9) WL, FTT
Medicaid Funded	0.0399	0.0059	-0.0038	0.0109	0.0016	0.0068	-0.0009	-0.0012	0.0016
	(0.0450)	(0.0090)	(0.0024)	(0.0238)	(0.0026)	(0.0043)	(0.0028)	(0.0019)	(0.0015)
Mean	0.913	0.184	0.057	0.468	0.054	0.038	0.051	0.067	0.030
N	617894	617894	295146	295146	617894	617894	617894	617894	617894

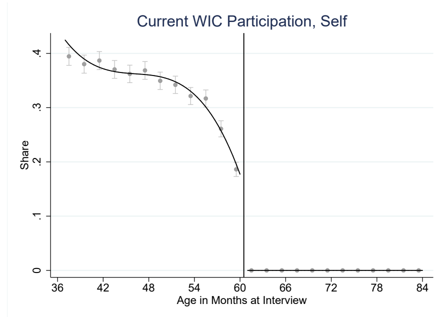
Notes: Each cell presents the coefficient of interest (β_2) from estimating the cubic specification of the running variable in Equation (2) for cell level counts of the outcome listed at the top of the column for the sample of Medicaid funded admissions. Standard errors (in parentheses) are clustered by age in months. * $p < .10$, ** $p < .05$, and *** $p < .01$.

Figure 1a: 60 Month Age Out, WIC Participation, SIPP

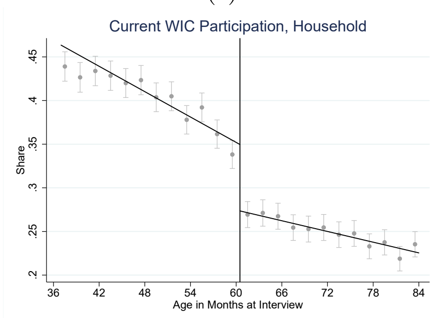
(a)



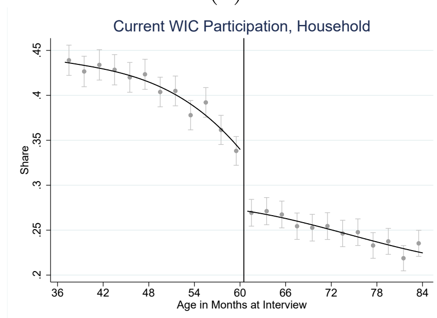
(b)



(c)



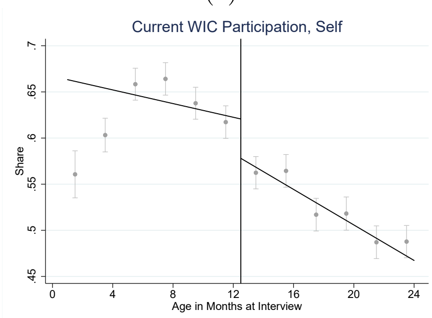
(d)



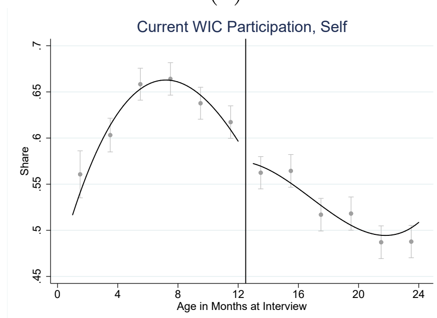
Notes: These figures provide the visual representation of the regression results for the first stage using the SIPP data for the sample of families with incomes below 200% of the FPL. The figures in the first row show the change in the child's own participation. The second row shows the change at the household level. Each dot on the figure represents the weighted share of children (or households) in that 2-month bin that report receiving WIC and the bars give the 95% confidence interval for the mean. The model, and the fitted line, in column one comes from the linear specification of the running variable in equation (1). The model, and the fitted line, in column two comes from the cubic specification of the running variable in equation (2). The distance between the fitted lines corresponds to the estimate of β_2.

Figure 1b: 12 Month, WIC Participation, SIPP

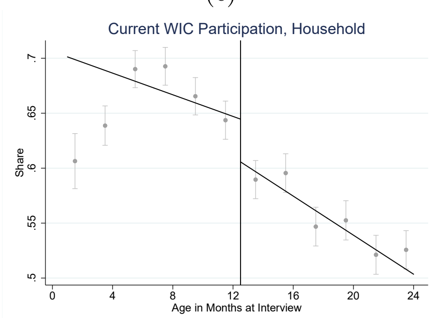
(a)



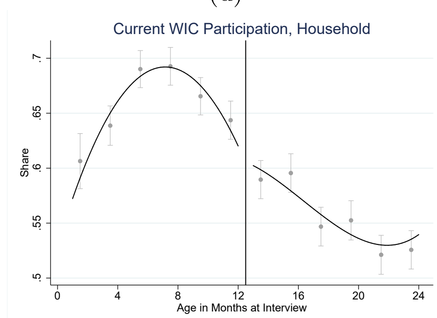
(b)



(c)

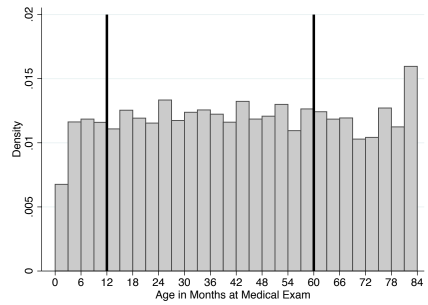


(d)



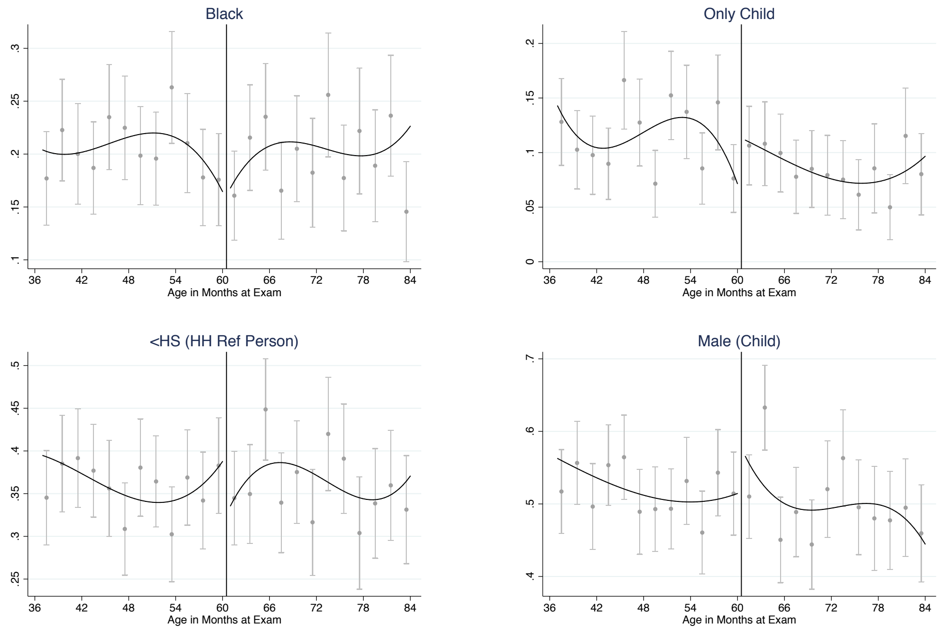
Notes: These figures provide the visual representation of the regression results for the first stage using the SIPP data for the sample of families with incomes below 200% of the FPL. The figures in the first row show the change in the child's own participation. The second row shows the change at the household level. Each dot on the figure represents the weighted share of children (or households) in that 2-month bin that report receiving WIC and the bars give the 95% confidence interval for the mean. The model, and the fitted line, in column one comes from the linear specification of the running variable in equation (1). The model, and the fitted line, in column two comes from the cubic specification of the running variable in equation (2). The distance between the fitted lines corresponds to the estimate of β_2.

Figure 2: NHANES Density Plot



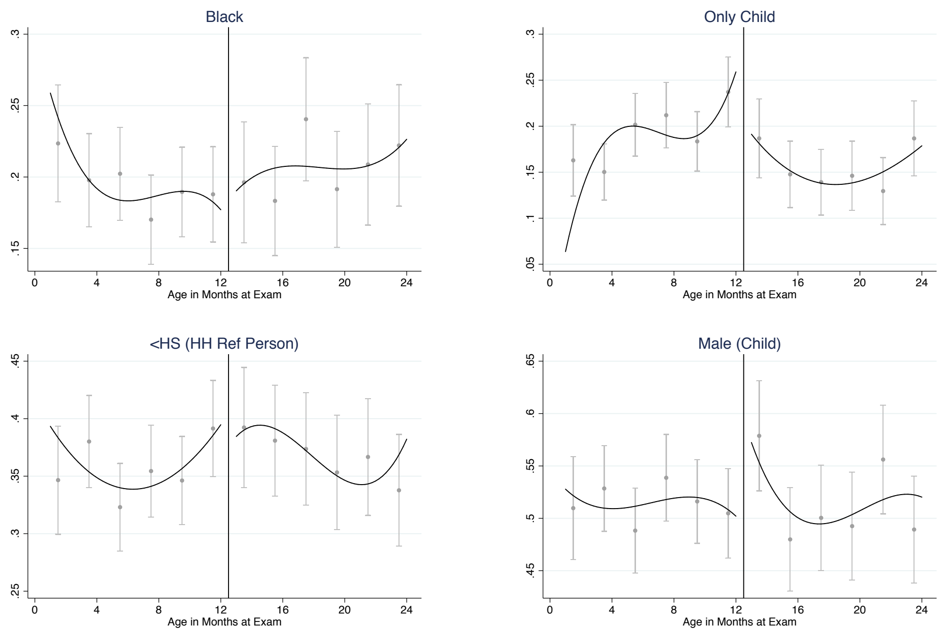
Notes: This figure gives the visual representation of the density test through 12 and 60 months in the NHANES data.

Figure 3: 60 Month Age Out, Balance Tests



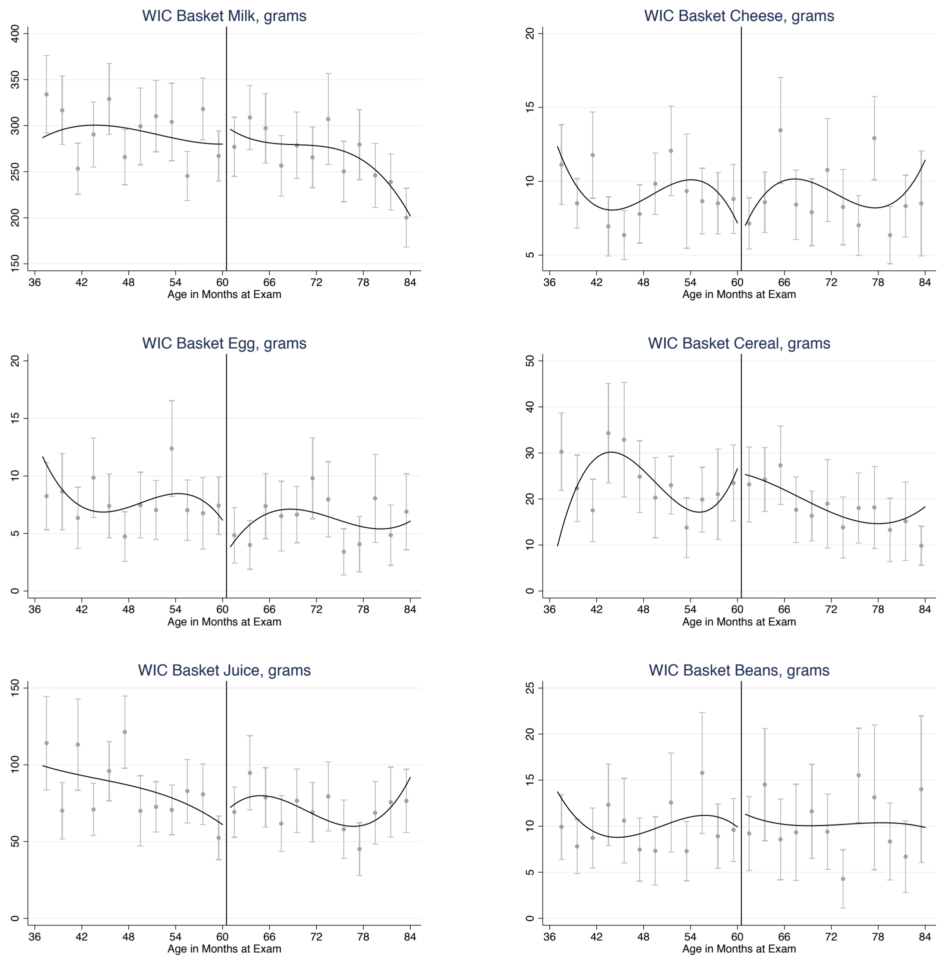
Notes: Each figure provides the visual representation of the regression results from estimating equation (2). Each dot on the figure represents the weighted mean of the outcome variable listed in the title, for children in that 2-month bin, and the bars give the 95% confidence interval for the mean. The model, and the fitted line, come from the cubic specification of the running variable in Equation (2). The distance between the fitted lines corresponds to the estimate of β_2.

Figure 4: 12 Month, Balance Tests



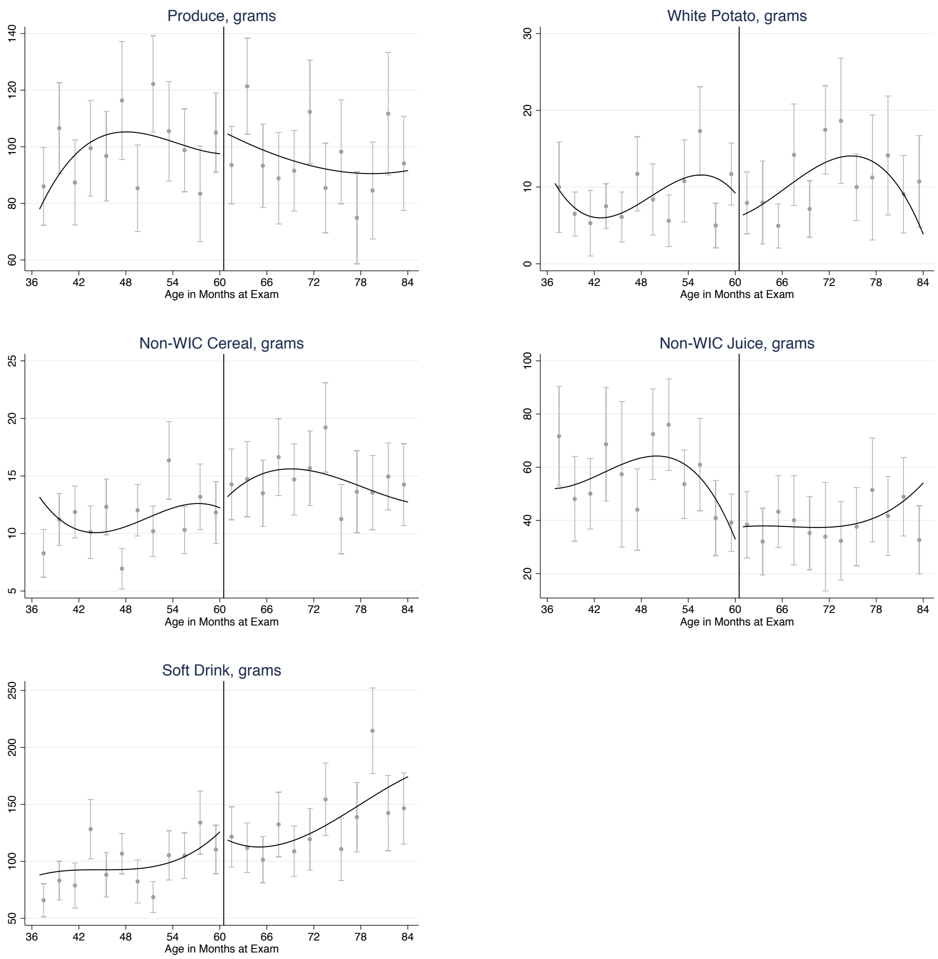
Notes: Each figure provides the visual representation of the regression results from estimating equation (2). Each dot on the figure represents the weighted mean of the outcome variable listed in the title, for children in that 2-month bin, and the bars give the 95% confidence interval for the mean. The model, and the fitted line, come from the cubic specification of the running variable in Equation (2). The distance between the fitted lines corresponds to the estimate of β_2.

Figure 5: 60 Month, Food Diary / Consumption: WIC Basket



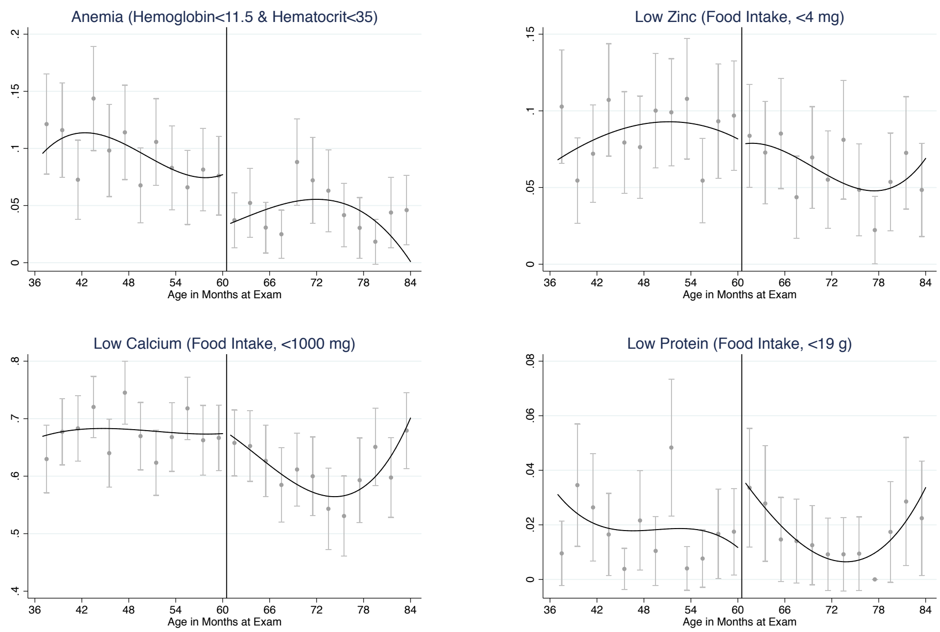
Notes: Each figure provides the visual representation of the regression results from estimating equation (2). Each dot on the figure represents the weighted mean of the outcome variable listed in the title, for children in that 2-month bin, and the bars give the 95% confidence interval for the mean. The model, and the fitted line, come from the cubic specification of the running variable in Equation (2). The distance between the fitted lines corresponds to the estimate of β_2.

Figure 5 (Cont.): 60 Month, Food Diary / Consumption



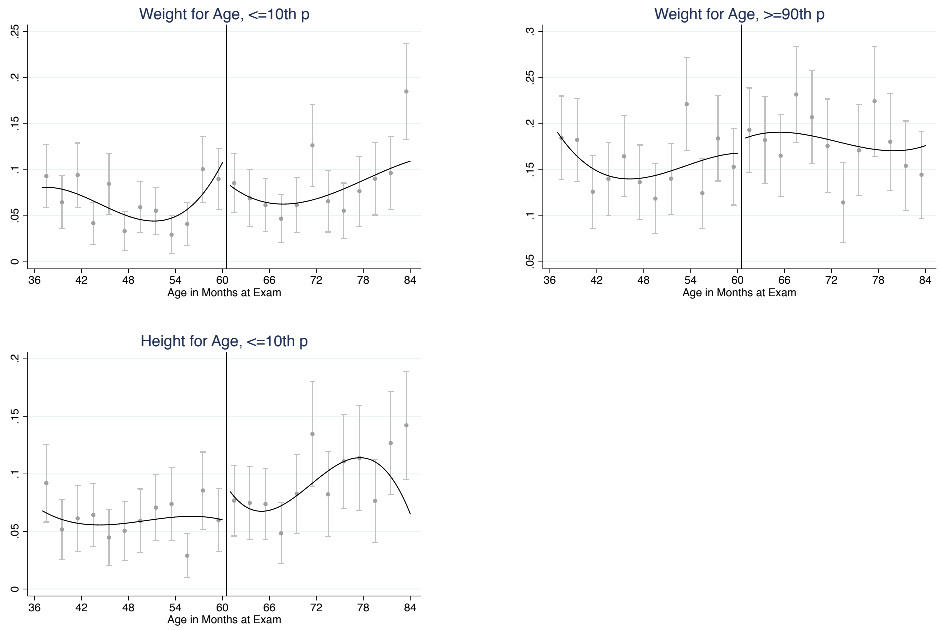
Notes: Each figure provides the visual representation of the regression results from estimating equation (2). Each dot on the figure represents the weighted mean of the outcome variable listed in the title, for children in that 2-month bin, and the bars give the 95% confidence interval for the mean. The model, and the fitted line, come from the cubic specification of the running variable in Equation (2). The distance between the fitted lines corresponds to the estimate of β_2.

Figure 6: 60 Month, Nutrients



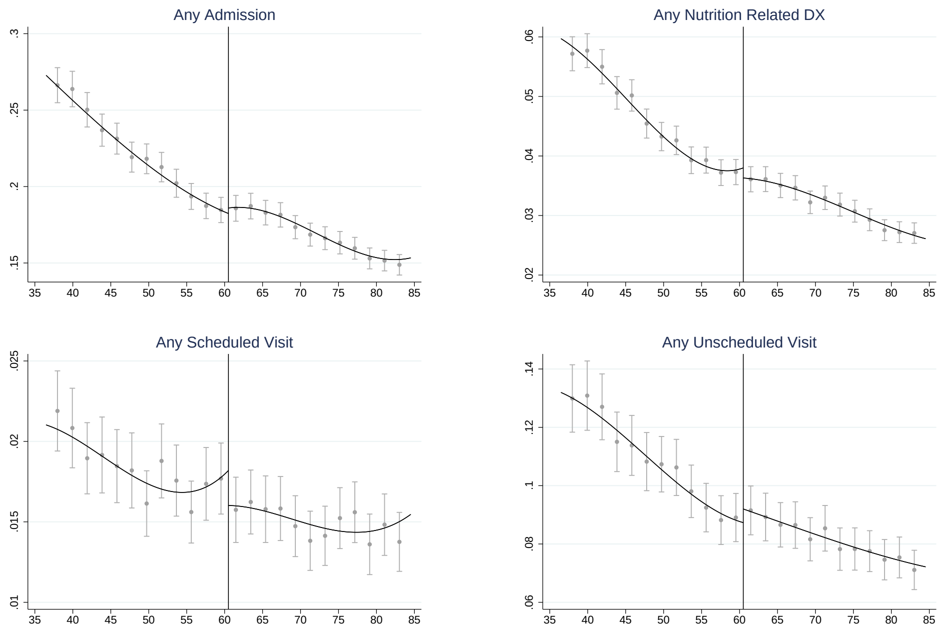
Notes: Each figure provides the visual representation of the regression results from estimating equation (2). Each dot on the figure represents the weighted mean of the outcome variable listed in the title, for children in that 2-month bin, and the bars give the 95% confidence interval for the mean. The model, and the fitted line, come from the cubic specification of the running variable in Equation (2). The distance between the fitted lines corresponds to the estimate of β_2.

Figure 7: 60 Month, Body Measurements



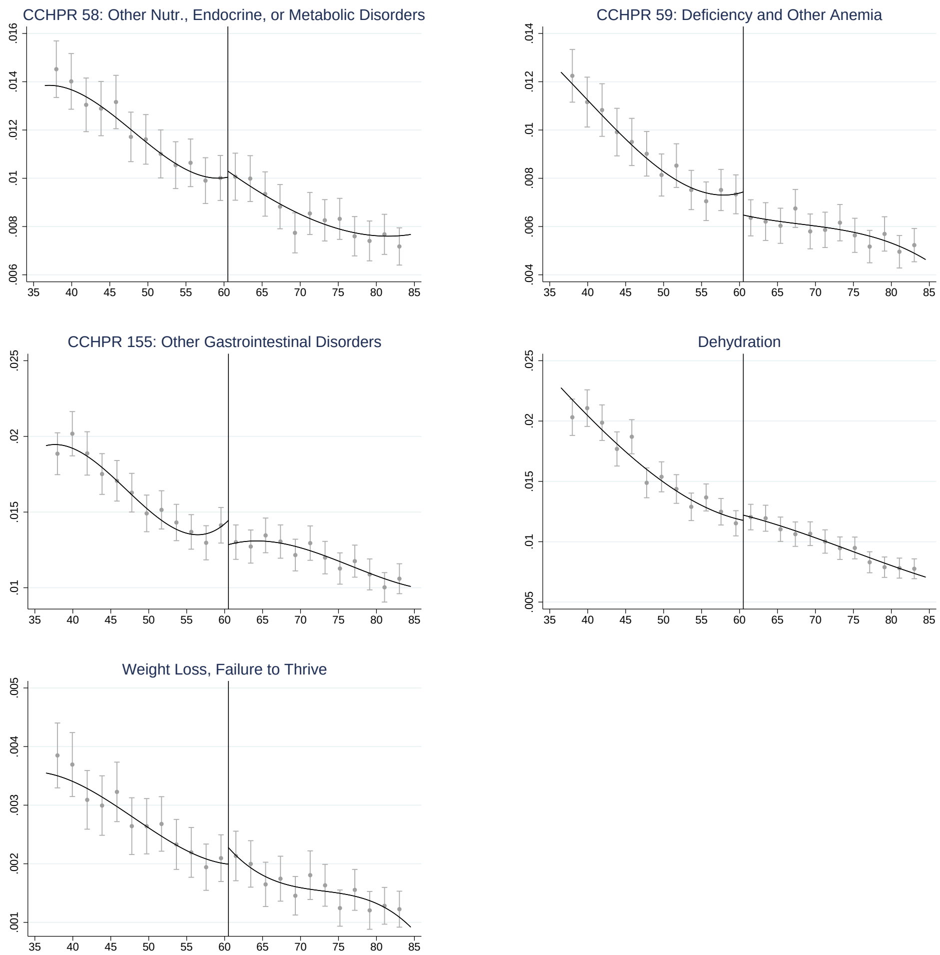
Notes: Each figure provides the visual representation of the regression results from estimating equation (2). Each dot on the figure represents the weighted mean of the outcome variable listed in the title, for children in that 2-month bin, and the bars give the 95% confidence interval for the mean. The model, and the fitted line, come from the cubic specification of the running variable in Equation (2). The distance between the fitted lines corresponds to the estimate of β_2.

Figure 8: 60 Month Age Out, HCUP Medicaid Funded Admissions



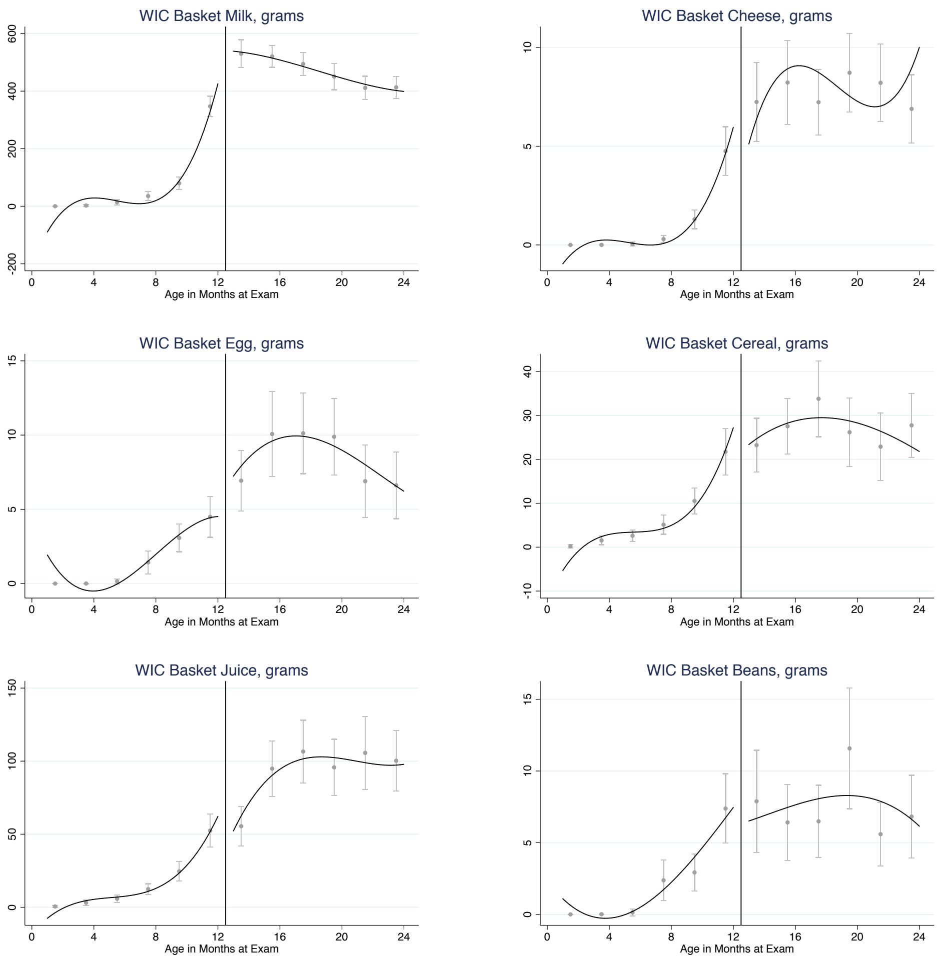
Notes: Each figure provides the visual representation of the regression results from estimating equation (2). Each dot on the figure represents the mean of the cell level count of the outcome variable listed in the title, for children in that 2-month bin, and the bars give the 95% confidence interval for the mean. The model, and the fitted line, come from the cubic specification of the running variable in Equation (2). The distance between the fitted lines corresponds to the estimate of β_2.

Figure 8 (Cont.):60 Month Age Out, HCUP Medicaid Funded Admissions



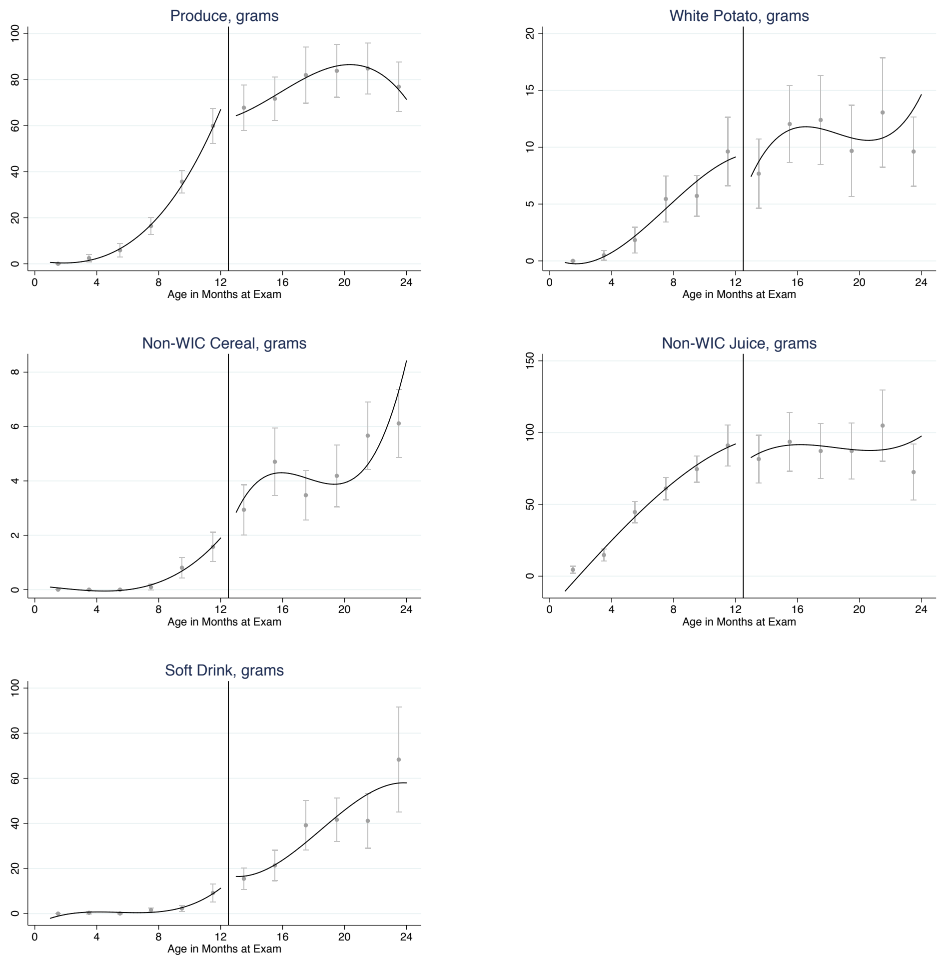
Notes: Each figure provides the visual representation of the regression results from estimating equation (2). Each dot on the figure represents the mean of the cell level count of the outcome variable listed in the title, for children in that 2-month bin, and the bars give the 95% confidence interval for the mean. The model, and the fitted line, come from the cubic specification of the running variable in Equation (2). The distance between the fitted lines corresponds to the estimate of β_2.

Figure 9: 12 Month, Food Diary / Consumption: WIC Basket



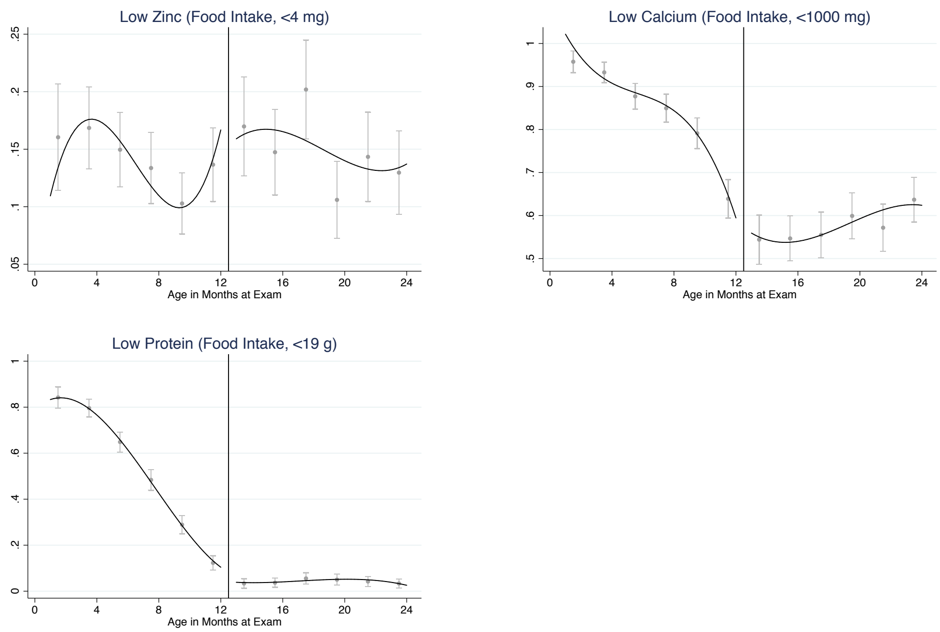
Notes: Each figure provides the visual representation of the regression results from estimating equation (2). Each dot on the figure represents the weighted mean of the outcome variable listed in the title, for children in that 2-month bin, and the bars give the 95% confidence interval for the mean. The model, and the fitted line, come from the cubic specification of the running variable in Equation (2). The distance between the fitted lines corresponds to the estimate of β_2.

Figure 9 (Cont.): 12 Month, Food Diary / Consumption



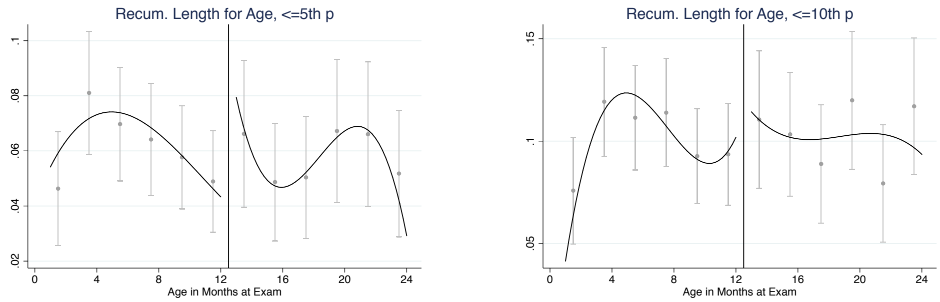
Notes: Each figure provides the visual representation of the regression results from estimating equation (2). Each dot on the figure represents the weighted mean of the outcome variable listed in the title, for children in that 2-month bin, and the bars give the 95% confidence interval for the mean. The model, and the fitted line, come from the cubic specification of the running variable in Equation (2). The distance between the fitted lines corresponds to the estimate of β_2.

Figure 10: 12 Month, Nutrients



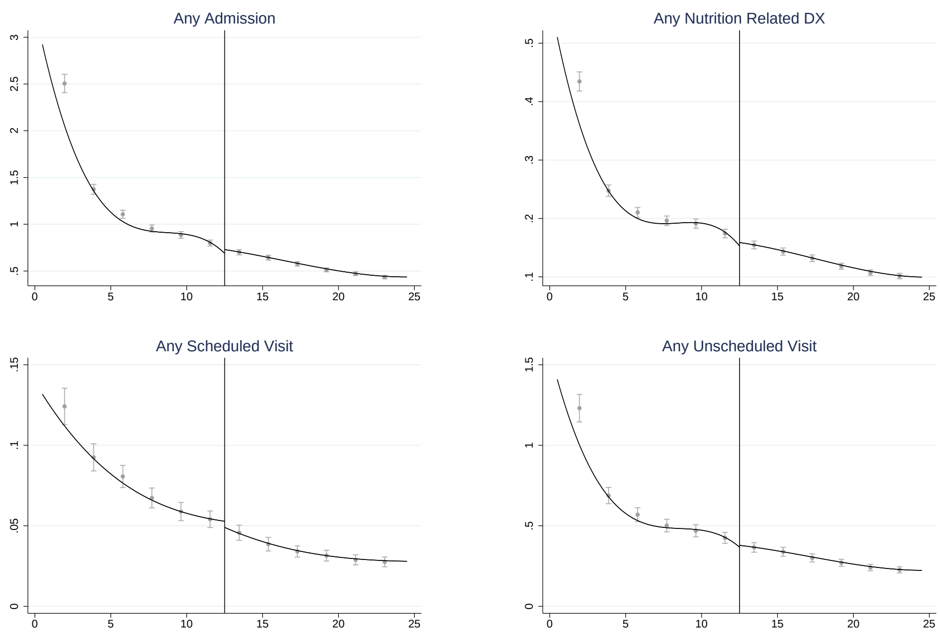
Notes: Each figure provides the visual representation of the regression results from estimating equation (2). Each dot on the figure represents the weighted mean of the outcome variable listed in the title, for children in that 2-month bin, and the bars give the 95% confidence interval for the mean. The model, and the fitted line, come from the cubic specification of the running variable in Equation (2). The distance between the fitted lines corresponds to the estimate of β_2.

Figure 11: 12 Month, Body Measurements



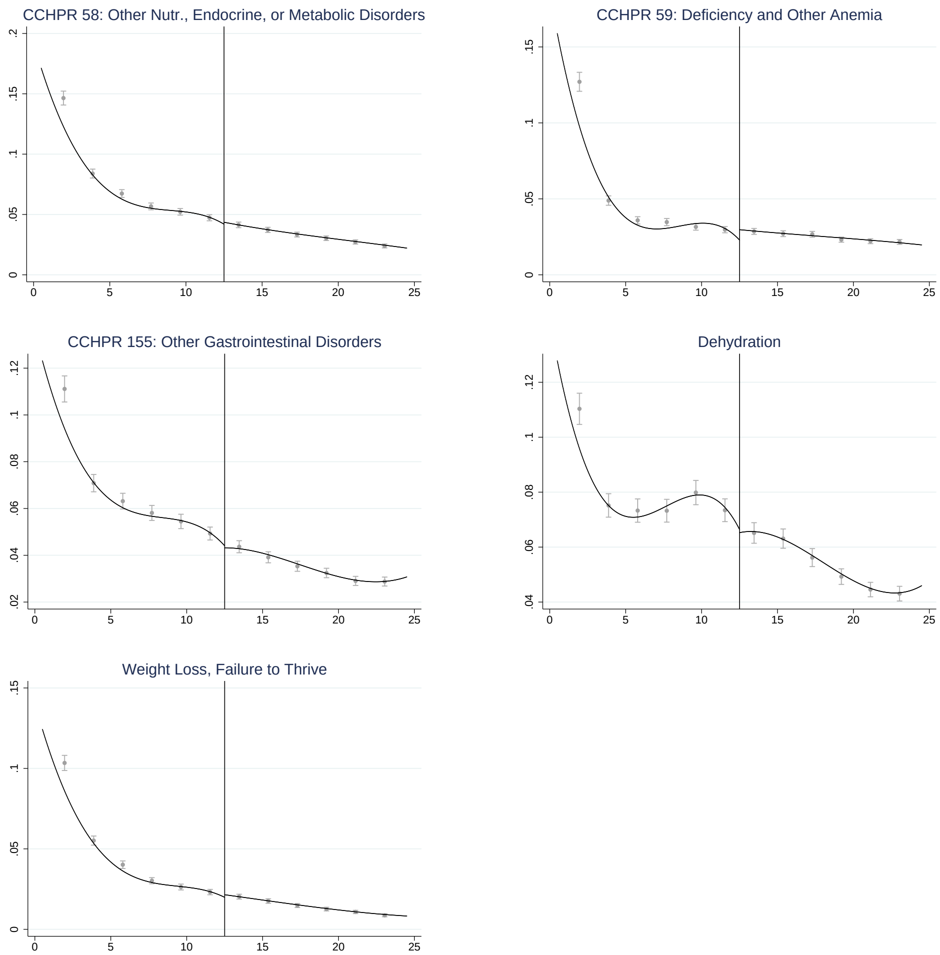
Notes: Each figure provides the visual representation of the regression results from estimating equation (2). Each dot on the figure represents the weighted mean of the outcome variable listed in the title, for children in that 2-month bin, and the bars give the 95% confidence interval for the mean. The model, and the fitted line, come from the cubic specification of the running variable in Equation (2). The distance between the fitted lines corresponds to the estimate of β_2.

Figure 12: 12 Month Age Out, HCUP Medicaid Funded Admissions



Notes: Each figure provides the visual representation of the regression results from estimating equation (2). Each dot on the figure represents the mean of the cell level count of the outcome variable listed in the title, for children in that 2-month bin, and the bars give the 95% confidence interval for the mean. The model, and the fitted line, come from the cubic specification of the running variable in Equation (2). The distance between the fitted lines corresponds to the estimate of β_2.

Figure 12 (Cont.):12 Month Age Out, HCUP Medicaid Funded Admissions



Notes: Each figure provides the visual representation of the regression results from estimating equation (2). Each dot on the figure represents the mean of the cell level count of the outcome variable listed in the title, for children in that 2-month bin, and the bars give the 95% confidence interval for the mean. The model, and the fitted line, come from the cubic specification of the running variable in Equation (2). The distance between the fitted lines corresponds to the estimate of β_2.

Table A1: 60 Month Ageout, WIC Variables NHANES

	Self		Household	
	Linear	Cubic	Linear	Cubic
Full	-0.0831***	0.0650**	-0.0662***	-0.0576**
	(0.0319)	(0.0257)	(0.0194)	(0.0239)
Mean	0.162	0.162	0.128	0.128
N	1219	1219	3967	3967
< 200% FPL	-0.1338*	0.1120*	-0.1148***	-0.1326***
	(0.0709)	(0.0620)	(0.0331)	(0.0353)
Mean	0.282	0.282	0.236	0.236
N	742	742	2503	2503
200-400% FPL	-0.0021	0.0141	0.0126	0.0330
	(0.0124)	(0.0166)	(0.0167)	(0.0370)
Mean	0.048	0.048	0.008	0.008
N	224	224	944	944
Black	0.0153	0.3157	0.0090	0.0531
	(0.1315)	(0.1999)	(0.0398)	(0.0582)
Mean	0.214	0.214	0.235	0.235
N	237	237	1273	1273
Only Child	-0.0626	-0.1774**	-0.0196	0.0793**
	(0.0509)	(0.0838)	(0.0472)	(0.0382)
Mean	0.077	0.077	0.043	0.043
N	140	140	469	469
Single Mother	-0.2098***	-0.0046	-0.0975**	-0.1137*
	(0.0723)	(0.1294)	(0.0439)	(0.0611)
Mean	0.253	0.253	0.239	0.239
N	268	268	1207	1207

Notes: Each cell presents the coefficient of interest (β_2) from estimating either the linear specification of the running variable in Equation (1) (columns 1 and 3) or the cubic specification of the running variable in Equation (2) (columns 2 and 4) for the subsample listed at the beginning of the row and the outcome listed at the top of the column. The first two columns show the change in the child's own participation. This question is only asked of children older than 60 months in the 2007 and 2009 waves, so those are the only waves used in these figures. The last two columns show the change at the household level. This question is only asked in the NHANES III. Standard errors (in parentheses) are clustered by age in months. Observations are weighted using NHANES sampling weights. * $p < .10$, ** $p < .05$, and *** $p < .01$.

Table A2: 12 Month Ageout, WIC Variables NHANES

	Self		Household	
	Linear	Cubic	Linear	Cubic
Full	-0.0359	0.0422**	-0.0257	0.0387**
	(0.0249)	(0.0178)	(0.0232)	(0.0196)
Mean	0.391	0.391	0.320	0.320
N	9287	9287	3533	3533
< 200% FPL	-0.0167	0.1025***	0.0457	0.0981**
	(0.0337)	(0.0228)	(0.0344)	(0.0475)
Mean	0.639	0.639	0.556	0.556
N	5553	5553	1953	1953
200-400% FPL	-0.0697***	-0.0567***	-0.0420	-0.0704*
	(0.0226)	(0.0194)	(0.0322)	(0.0361)
Mean	0.156	0.156	0.064	0.064
N	1958	1958	918	918
Black	-0.0466	-0.0751*	-0.0514	0.0285
	(0.0483)	(0.0452)	(0.1002)	(0.1212)
Mean	0.608	0.608	0.566	0.566
N	1933	1933	743	743
Only Child	-0.1278***	-0.0304	-0.1108*	0.0099
	(0.0474)	(0.0389)	(0.0623)	(0.0768)
Mean	0.250	0.250	0.212	0.212
N	1904	1904	895	895
Single Mother	-0.1328***	-0.0705**	0.0389	0.3469***
	(0.0302)	(0.0334)	(0.1225)	(0.0856)
Mean	0.650	0.650	0.662	0.662
N	1969	1969	808	808

Notes: Each cell presents the coefficient of interest (β_2) from estimating either the linear specification of the running variable in Equation (1) (columns 1 and 3) or the cubic specification of the running variable in Equation (2) (columns 2 and 4) for the subsample listed at the beginning of the row and the outcome listed at the top of the column. The first two columns show the change in the child's own participation. The last two columns show the change at the household level. This question is only asked in the NHANES III. Standard errors (in parentheses) are clustered by age in months. Observations are weighted using NHANES sampling weights. * $p < .10$, ** $p < .05$, and *** $p < .01$.

Table A3: 60 Month, Balance Tests

(a) 60 Months

	(1) Black	(2) Only Child	(3) HH Ref <HS	(4) Male
< 200% FPL	0.0040	0.0521**	-0.0684	0.0604
	(0.0286)	(0.0238)	(0.0448)	(0.0572)
Mean	0.201	0.100	0.360	0.509
N	6324	6076	6283	6324

(b) 12 Months

< 200% FPL	0.0142	-0.0854***	-0.0284	0.1005*
	(0.0314)	(0.0223)	(0.0316)	(0.0552)
Mean	0.201	0.174	0.362	0.514
N	5477	5056	5413	5477

Notes: Each cell presents the coefficient of interest (β_2) from estimating the cubic specification of the running variable in Equation (2) for the subsample listed at the beginning of the row and the outcome listed at the top of the column. Standard errors (in parentheses) are clustered by age in months. Observations are weighted using NHANES sampling weights. * $p < .10$, ** $p < .05$, and *** $p < .01$.

Table A4: 60 Month Age Out, HCUP Medicaid Funded Admissions (With Controls)

	(1) Any Adm.	(2) Any Nut.	(3) Sched	(4) Unsched	(5) CCHPR 58	(6) CCHPR 59	(7) CCHPR 155	(8) Dehyd.	(9) WL, FTT
Medicaid Funded	0.0034	-0.0017	-0.0022***	0.0042	0.0002	-0.0010***	-0.0016**	0.0004	0.0003
	(0.0054)	(0.0013)	(0.0008)	(0.0040)	(0.0006)	(0.0004)	(0.0007)	(0.0005)	(0.0002)
Mean	0.195	0.039	0.017	0.095	0.010	0.007	0.014	0.013	0.002
N	1235786	1235786	589338	589338	1235786	1235786	1235786	1235786	1235786

Notes: Each cell presents the coefficient of interest (β_2) from estimating the cubic specification of the running variable in Equation (2) for cell level counts of the outcome listed at the top of the column for the sample of Medicaid funded admissions. All regressions include cell level population as a control variable, as well as gender, year and race fixed effects. Standard errors (in parentheses) are clustered by age in months. * $p < .10$, ** $p < .05$, and *** $p < .01$.

Table A5: 12 Month Age Out, HCUP Medicaid Funded Admissions (With Controls)

	(1) Any Adm.	(2) Any Nut.	(3) Sched	(4) Unsched	(5) CCHPR 58	(6) CCHPR 59	(7) CCHPR 155	(8) Dehyd.	(9) WL, FTT
Medicaid Funded	0.0388	0.0056	-0.0039	0.0098	0.0015	0.0068	-0.0009	-0.0013	0.0016
	(0.0465)	(0.0093)	(0.0025)	(0.0252)	(0.0026)	(0.0043)	(0.0029)	(0.0020)	(0.0016)
Mean	0.913	0.184	0.057	0.468	0.054	0.038	0.051	0.067	0.030
N	617894	617894	295146	295146	617894	617894	617894	617894	617894

Notes: Each cell presents the coefficient of interest (β_2) from estimating the cubic specification of the running variable in Equation (2) for cell level counts of the outcome listed at the top of the column for the sample of Medicaid funded admissions. All regressions include cell level population as a control variable, as well as gender, year and race fixed effects. Standard errors (in parentheses) are clustered by age in months. * $p < .10$, ** $p < .05$, and *** $p < .01$.

Table A6: 12 Month, Food Diary / Consumption

	WIC Basket										
	(1) Milk	(2) Cheese	(3) Eggs	(4) Cereal	(5) Juice	(6) Beans	(7) Produce	(8) White Potato	(9) High Sug. Cereal	(10) Fruit Drink	(11) Soda
< 200% FPL	2.3347	-3.9552	1.9503	-11.1645	-33.6961**	-1.8494	-12.0997	-3.5447	-0.0599	-15.0863	2.8566
	(25.1474)	(3.0763)	(2.1526)	(7.4343)	(13.7624)	(3.5146)	(7.7478)	(2.9477)	(0.4199)	(9.7906)	(6.1290)
Mean	272.255	4.364	4.969	16.899	54.554	4.767	48.624	7.299	2.443	68.346	19.834
N	5262	5262	5262	5262	5262	5262	5262	5262	5262	5262	5262

Notes: Each cell presents the coefficient of interest (β_2) from estimating the cubic specification of the running variable in Equation (2) for the subsample listed at the beginning of the row and the outcome listed at the top of the column. Standard errors (in parentheses) are clustered by age in months. Observations are weighted using NHANES sampling weights. * $p < .10$, ** $p < .05$, and *** $p < .01$.

Table A7: 12 Month, Nutrients

	(1) Low Zinc	(2) Low Calc.	(3) Low Prot.
< 200% FPL	-0.0451*	0.0369**	-0.0411**
	(0.0252)	(0.0179)	(0.0203)
Mean	0.145	0.692	0.251
N	4521	4521	4521

Notes: Each cell presents the coefficient of interest (β_2) from estimating the cubic specification of the running variable in Equation (2) for the subsample listed at the beginning of the row and the outcome listed at the top of the column. Standard errors (in parentheses) are clustered by age in months. Observations are weighted using NHANES sampling weights. * $p < .10$, ** $p < .05$, and *** $p < .01$.

Table A8: 12 Month, Body Measurements

	(1) Recum Length <=5th p	(2) Recum Length <=10th p
< 200% FPL	0.0533***	0.0075
	(0.0151)	(0.0169)
Mean	0.060	0.103
N	5421	5421

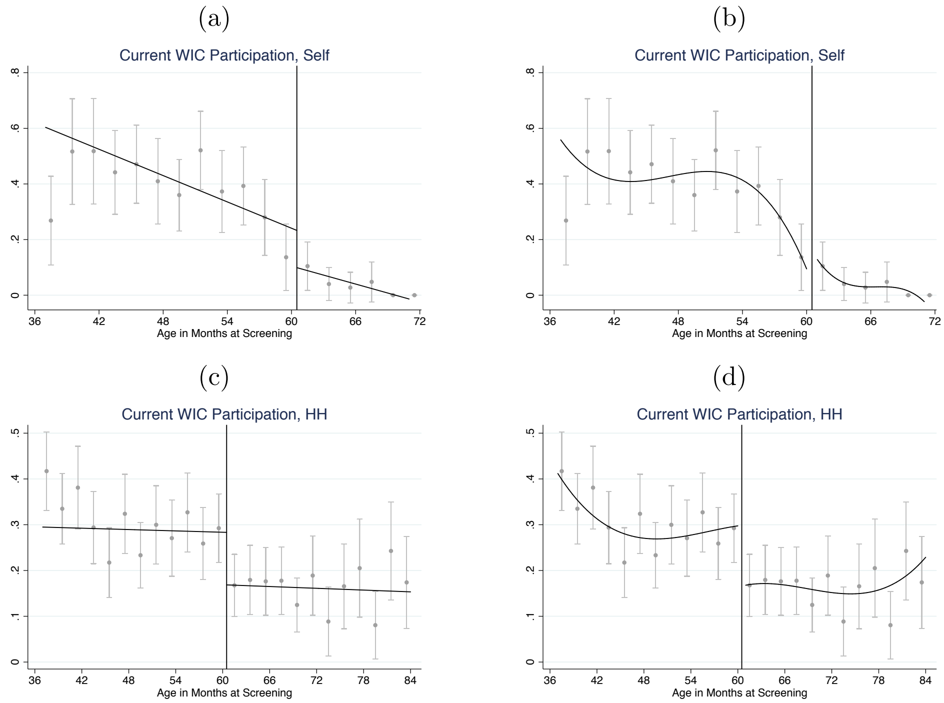
Notes: Each cell presents the coefficient of interest (β_2) from estimating the cubic specification of the running variable in Equation (2) for the subsample listed at the beginning of the row and the outcome listed at the top of the column. Standard errors (in parentheses) are clustered by age in months. Observations are weighted using NHANES sampling weights. * $p < .10$, ** $p < .05$, and *** $p < .01$.

Table A9: HCUP Variables

Variable Name	Variable Label	Source	ICD-9 codes
CCHPR 52	Nutritional deficiencies	HCUP Clinical Classifications for Health Policy Research	260 261 262 2630 2631 2632 2638 2639 2640 2641 2642 2643 2644 2645 2646 2647 2648 2649 2650 2651 2652 2660 2661 2662 2669 267 2680 2681 2682 2689 2690 2691 2692 2693 2698 2699 7994 V121
CCHPR 58	Other nutritional; endocrine; and metabolic disorders	HCUP Clinical Classifications for Health Policy Research	2700 2701 2702 2703 2704 2705 2706 2707 2708 2709 2710 2711 2712 2713 2714 2718 2719 2725 2726 2727 2728 2729 2730 2731 2732 2733 2734 2738 2739 2750 27501 27502 27503 27509 2751 2752 2753 2754 27540 27541 27542 27549 2755 2758 2759 2771 2772 2773 27730 27731 27739 2774 2775 2776 2777 2778 27781 27782 27784 27785 27786 27787 27789 2779 2780 27800 27801 27802 27803 2781 2782 2783 2784 2788 7831 7832 78321 78322 7833 7834 78340 78341 78342 78343 7835 7837 7839 79391 7947 7957 V122 V1221 V1229 V850 V8521 V8522 V8523 V8524 V8525 V8530 V8531 V8532 V8533 V8534 V8535 V8536 V8537 V8538 V8539 V854 V8541 V8542 V8543 V8544 V8545 V8551 V8553 V8554
CCHPR 59	Deficiency and other anemia	HCUP Clinical Classifications for Health Policy Research	2800 2801 2808 2809 2810 2811 2812 2813 2814 2818 2819 2820 2821 2822 2823 2824 28240 28243 28244 28245 28246 28247 28249 2827 2828 2829 2830 2831 28310 28311 28319 2832 2839 2840 28401 28409 2841 28411 28412 28419 2842 2848 28481 28489 2849 2850 28521 28522 28529 2858 2859
CCHPR 155	Other gastrointestinal disorders	HCUP Clinical Classifications for Health Policy Research	538 5581 5582 5640 56400 56401 56402 56409 5641 5645 5647 5648 56481 56489 5649 5680 56881 56882 56889 5689 56981 56982 56983 56984 56985 56986 56987 56989 5699 5790 5791 5792 5798 5799 7871 7872 78720 78721 78722 78723 78724 78729 7873 7874 7875 7876 78760 78761 78762 78763 7877 7879 78791 78799 7892 7893 78930 78931 78932 78933 78934 78935 78936 78937 78939 7894 78940 78941 78942 78943 78944 78945 78946 78947 78949 7899 7921 7934 7936 V127 V1270 V1279 V416 V441 V442 V443 V444 V453 V473 V535 V5350 V5351 V5359 V551 V552 V553 V554
Dehydration		Author selected	27651
WL,FTT	Weight Loss, Failure to Thrive	Weiss et al. (2013)	78321 7833 78341 7837
PN	Postsurgical nonabsorption	Weiss et al. (2013)	5793
NN	Nutritional neglect	Weiss et al. (2013)	99552 99584
Cach	Cachexia	Weiss et al. (2013)	7994
PCM	Protein-calorie malnutrition	Weiss et al. (2013)	260 261 262 2630 2631 2632 2638 2639
Under	Underweight	Weiss et al. (2013)	78322 V850 V8551
Any Nut.	Any Nutrition Related DX		Any category above

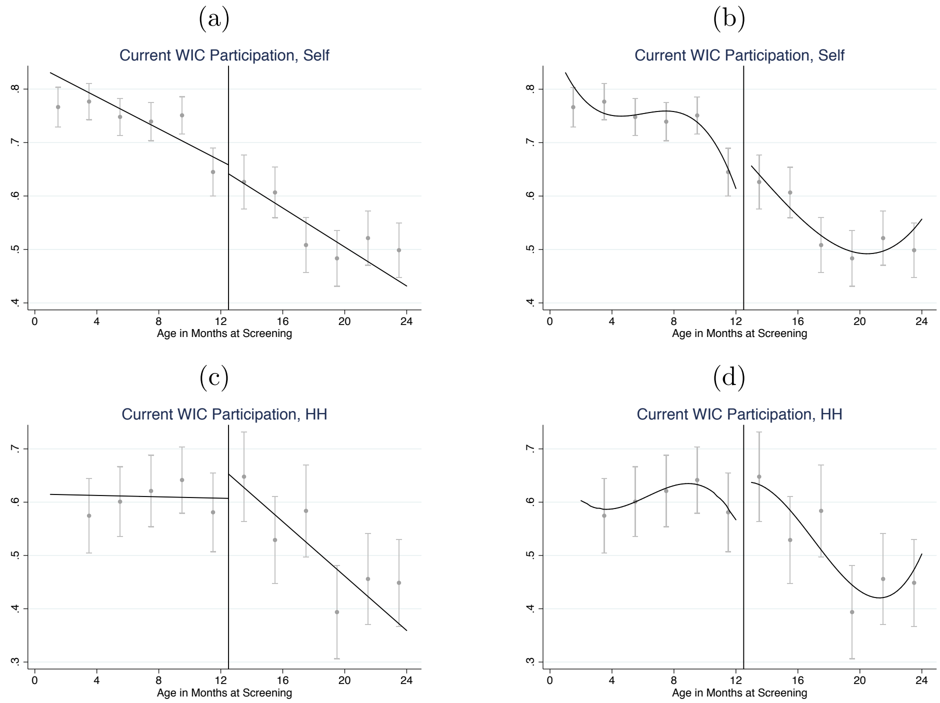
Notes: This table describes the diagnosis categories used in the HCUP analysis.

Figure A1: 60 Month Age Out, WIC Participation, NHANES



Notes: These figures provide the visual representation of the regression results for the first stage using the NHANES data for the sample of families with incomes below 200% of the FPL. The figures in the first row show the change in the child's own participation. This question is only asked of children older than 60 months in the 2007 and 2009 waves, so those are the only waves used in these figures. The second row shows the change at the household level. This question is only asked in the NHANES III. Each dot on the figure represents the weighted share of children (or households) in that 2-month bin that report receiving WIC and the bars give the 95% confidence interval for the mean. The model, and the fitted line, in column one comes from the linear specification of the running variable in equation (1). The model, and the fitted line, in column two comes from the cubic specification of the running variable in equation (2). The distance between the fitted lines corresponds to the estimate of β_2.

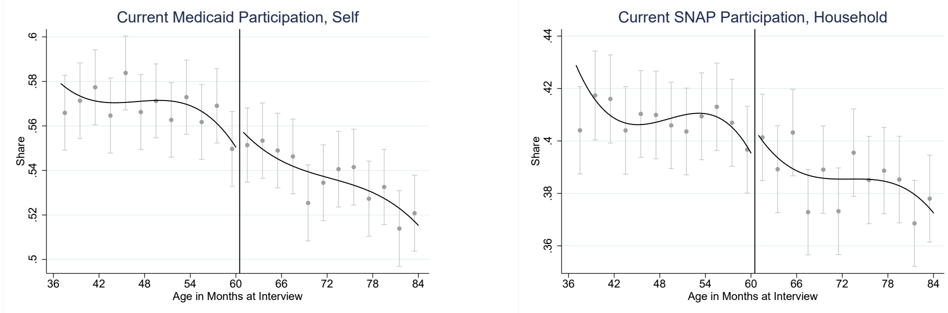
Figure A2: 12 Month Age Out, WIC Participation, NHANES



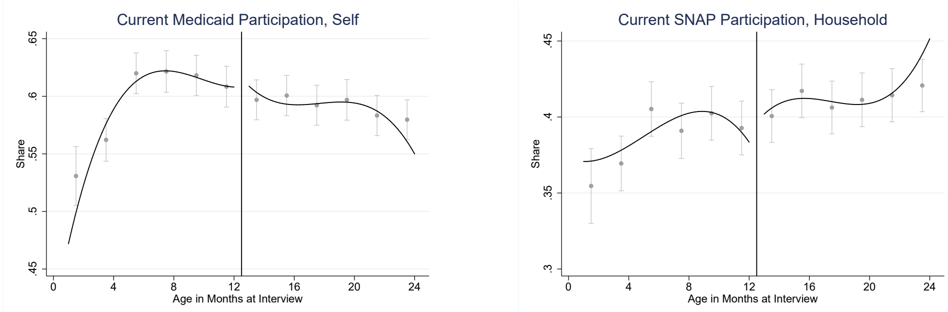
Notes: These figures provide the visual representation of the regression results for the first stage using the NHANES data for the sample of families with incomes below 200% of the FPL. The figures in the first row show the change in the child's own participation. The second row shows the change at the household level. This question is only asked in the NHANES III. Each dot on the figure represents the weighted share of children (or households) in that 2-month bin that report receiving WIC and the bars give the 95% confidence interval for the mean. The model, and the fitted line, in column one comes from the linear specification of the running variable in equation (1). The model, and the fitted line, in column two comes from the cubic specification of the running variable in equation (2). The distance between the fitted lines corresponds to the estimate of β_2.

Figure A3: Medicaid and SNAP Participation

(a) 60 Months



(b) 12 Months



Notes: These figures provide the visual representation of the regression results for Medicaid and SNAP participation for the sample of families with incomes below 200% of the FPL. The figures in panel (a) show the change in participation at 60 months and panel (b) shows the change at 12 months. Each dot on the figure represents the weighted share of children (or households) in that 2-month bin that report receiving program benefits and the bars give the 95% confidence interval for the mean. The model, and the fitted line, come from the linear specification of the running variable in equation (1). The distance between the fitted lines corresponds to the estimate of β_2.