United States Department of Agriculture

Economic Research Service

Economic Information Bulletin Number 179

September 2017

# The Differences in Characteristics Among Households With and Without Obese Children: Findings From USDA's FoodAPS

Young Jo

United States Department of Agriculture

Economic Research Service
www.ers.usda.gov

**Recommended citation format for this publication:**

Young Jo. *The Differences in Characteristics Among Households With and Without Obese Children: Findings From USDA's FoodAPS,* EIB-179, U.S. Department of Agriculture, Economic Research Service, September 2017.

United States Department of Agriculture

**Economic Research Service**

Economic Information Bulletin Number 179

September 2017

# The Differences in Characteristics Among Households With and Without Obese Children: Findings From USDA's FoodAPS

Young Jo

## Abstract

Though the obesity rate for children in the United States has reached an unprecedented level, not all children face the same risk. Using data from USDA's 2012 National Household Food Acquisition and Purchase Survey (FoodAPS), this study examines characteristics of households with at least one obese child (obese-child households) and without any obese children (nonobese-child households) to understand potential reasons behind the dissimilar risks. Children from obese-child households tend to live in a more disadvantageous household and food environment than children from nonobese-child households. Their parents are more likely to be unmarried, less educated, financially constrained, and obese. Obese-child households tend to be located in areas with lower access to healthful foods. Children from obese-child households eat breakfast less frequently than children from nonobese-child households; however, the difference in the nutritional quality of food acquired by the two household types is not statistically significant.

**Keywords:** FoodAPS, National Household Food Acquisition and Purchase Survey, obesity, children, food environment, HEI, Healthy Eating Index

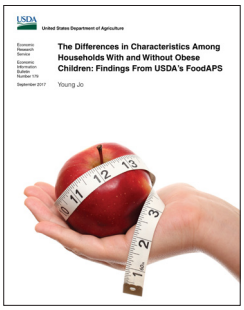
## Acknowledgments

The author would like to thank the following peer reviewers for their insightful comments: Lisa Mancino (USDA, Economic Research Service (ERS)), Carolyn Dimitri (New York University), Wen You (Virginia Polytechnic Institute and State University), and Kameron Burt and Barbara Murphy (USDA, Food and Nutrition Service). The author is also thankful to Diansheng Dong (ERS) and Jean Buzby (ERS) for their comments. Thanks also to John Weber and Curtia Taylor of ERS for editing and design assistance.

# Contents

United States Department of Agriculture

*A report summary from the Economic Research Service* *September 2017*




# The Differences in Characteristics Among Households With and Without Obese Children: Findings From USDA's FoodAPS

Young Jo

## What Is the Issue?

Childhood obesity rates in the United States have more than doubled in the past three decades. As obese children tend to become obese adults with poor health and low socioeconomic status, a better understanding of factors that may lead to obesity at a young age will aid in the development of efforts to reverse this costly trend. This study examines characteristics and food environments of households with at least one obese child (obese-child households) and without any obese children (nonobese-child households) to identify potential factors that could explain high obesity rates among some children.

## What Did the Study Find?

Children from obese-child households tend to live in a more disadvantageous environment than children from nonobese-child households:

- Children from obese-child households are more likely to live with parents who are not married, have lower education levels, are financially constrained, and are obese themselves.
- Obese-child households are typically located in areas with lower access to food outlets that sell healthful foods. In urban areas, obese-child households live in areas with easier access to and greater availability of convenience stores than nonobese-child households. Convenience stores typically sell nonperishable processed items. In rural areas, obese-child households live in areas with less availability of superstores and supermarkets than nonobese-child households. Superstores and supermarkets consistently sell healthful foods.

For obese- and nonobese-child households, most of the differences in eating patterns and the nutritional quality of food acquired from food outlets are not statistically significant:

- The number of times households eat dinner out or at home and the number of times children eat lunch, dinner, and snacks during the week are not different across the household types.
- Children from nonobese-child households, however, eat breakfast 5 percent more often than children from obese-child households.

- The overall nutritional quality of acquired food is similar, except nonobese-child households acquire more seafood and plant proteins, particularly from food prepared away from home.
- Survey respondents from obese-child households rate their diet quality to be slightly higher than respondents do from nonobese-child households and cite high food prices and poor taste of healthful foods as barriers to eating better.

## How Was the Study Conducted?

This study uses data from USDA's 2012 National Household Food Acquisition and Purchase Survey (FoodAPS). FoodAPS is a nationally representative survey of food purchases and acquisitions by 4,826 households during a 1-week period between April 2012 and January 2013. The study provides weighted estimates of sample means for demographic characteristics, financial well-being, food environments, eating patterns, nutritional quality of acquired food, and attitudes toward healthy eating by the presence of an obese child in the households. It compares results for households with at least one obese child to those without an obese child and highlights statistically significant differences using t-tests.

# The Differences in Characteristics Among Households With and Without Obese Children: Findings From USDA's FoodAPS

## Introduction

The prevalence of childhood obesity in the United States has more than doubled in the last three decades (Ogden et al., 2014). However, not all children face the same risk. Children from households with low socioeconomic status are more likely to be obese than children from households with relatively higher socioeconomic status (Anderson et al., 2009; Jo, 2014; Lin, 2005).[1] Moreover, obesity rates for non-Hispanic Black children and Hispanic children are higher than those for non-Hispanic White children. For example, Ogden et al. (2014) note that the obesity rate for non-Hispanic Whites age 2-19 was 28.5 percent in 2011, compared with 35.2 percent for non-Hispanic Blacks and 38.9 percent for Hispanics in the same age group. Why are some children more likely to be obese than others?

Previous studies highlight a range of factors—such as maternal employment (Anderson et al., 2003; Datar et al., 2014; Jo and Wang, 2017; Phipps et al., 2006; Ruhm, 2008), participation in school meal programs (Bhattacharya et al., 2006; Capogrossi and You, 2016; Gundersen et al., 2012; Schanzenbach, 2009), and food environments[2] (Carroll-Scott et al., 2013; Laska et al., 2010; Zick et al., 2009)—that may increase the likelihood of obesity in children. While most of these factors likely have some impact on children's weight, no single factor has been identified as the main contributor to childhood obesity.

Instead of focusing on one specific factor, USDA's 2012 National Household Food Acquisition and Purchase Survey (FoodAPS) provides a unique opportunity to examine a comprehensive picture of the household characteristics and neighborhood food environments of children. A high correlation between parents' and children's weights suggests that the household characteristics and food environments they share may account for the unequal weight status among children. This study examines differences between households with an obese child (hereafter referred to as obese-child households) and households without an obese child (nonobese-child households).[3] Factors considered include demographic characteristics, financial well-being, the food environment, eating patterns, and the nutritional quality of food acquired. The averages using sample weights are compared between the groups, and statistically significant differences are tested using t-tests.

---

[1] Children have a similar body mass index distribution after birth and even until kindergarten. However, the body weight of children with low socioeconomic status grows faster with age relative to that of children with higher socioeconomic status, whereas the growth rates of height remain similar. This results in gaps in obesity rates across children from various socioeconomic status (Jo, 2014; Murasko, 2009; Murasko, 2013).

[2] A food environment comprises the physical presence of food that affects a person's diet: a person's proximity to food store locations; the distribution of food stores, food service, and any physical entity by which food can be obtained; or a connected system that allows access to food (Centers for Disease Control and Prevention, 2017).

[3] Households are categorized in this study based on the presence of an obese child in a household rather than the prevalence of obese children or the presence of an obese parent. Categorizing households based on the prevalence of obese children (e.g., households where all children are obese, some children are obese, or no child is obese) results in the same qualitative findings as categorizing them based on the presence of an obese child, but the latter method provides a simpler comparison. Categorizing households based on the presence of an obese parent also results in consistent findings because parents' and children's weights are highly correlated. However, the sample size of households with obese parents is smaller because of missing information on parents' weight in FoodAPS.

# Description of Data

The main source of data for this study is the 2012 National Household Food Acquisition and Purchase Survey. FoodAPS is a nationally representative survey that collected information on food purchases and food acquisitions by 4,826 households during a 1-week period between April 2012 and January 2013.[4] The survey oversampled two groups of low-income households: participants in USDA's Supplemental Nutrition Assistance Program (SNAP) and eligible nonparticipants. Primary respondents—the main food shoppers or meal planners for FoodAPS households—provided information on household demographic and socioeconomic characteristics, dietary behaviors, and health.[5]

## Body mass index

One of the unique features of FoodAPS is that it asked the primary respondents to report height and weight of all household members age 2 and older. The obesity status of a child is determined by comparing the individual's body mass index (BMI)[6] with corresponding percentiles in the Centers for Disease Control and Prevention's (CDC) age- and sex-specific growth chart. Children age 2-17 with BMIs between the 85th and the 95th percentile are considered "overweight," whereas children with BMIs greater than the 95th percentile are considered "obese."[7] Because the primary respondent was asked to report each household member's information rather than have a trained health professional obtain the measurements, some degree of error is expected in the responses. Following the method employed by Cawley (2004), this analysis uses data from another nationally representative survey, the CDC's 2011-12 National Health and Nutrition Examination Survey (NHANES), to correct FoodAPS data on young children's heights (see box "The Quality of Height and Weight Information in FoodAPS and Correcting for Measurement Errors").

### The Quality of Height and Weight Information in FoodAPS and Correcting for Measurement Errors

To examine the quality of height and weight information in the National Household Food Acquisition and Purchase Survey (FoodAPS), the FoodAPS data are compared with data from the 2011-12 National Health and Nutrition Examination Survey (NHANES). The main purpose of NHANES, which is conducted by the Centers for Disease Control and Prevention - National Center for Health Statistics, is to assess the health and nutrition status of adults and children in the United States. NHANES collects information from a nationally representative sample of

[4] In this study, the word "acquisition" is used to encompass food bought at stores or restaurants as well as food acquired for free from places such as food pantries.

[5] For more details on FoodAPS, see the ERS website. For a description of variables used in the analysis, see appendix table 3.

[6] Body mass index (BMI) is calculated by dividing weight in pounds by the square of height in inches, multiplied by 703 [(lbs/inch^2) x 703]. Although BMI cannot distinguish muscle mass from fat (Burkhauser and Cawley, 2008; Wada and Tekin, 2010), it is the most commonly used measure of weight status because (1) height and weight are relatively easy to collect during surveys and (2) medical studies show that BMI is still a reliable measure in predicting illnesses (Haslam and James, 2005; Mokdad et al., 2003; Power et al., 1997).

[7] The percentile cutoffs are fixed over time but do vary depending on the age and sex of children. For example, a 4-year-old boy with a BMI of 18.5 is obese, whereas a 10-year-old boy with the same BMI is normal weight. The cutoffs are also fixed for adults age 18 and older. Regardless of an adult's age and sex, BMI between 25 and 30 is "overweight," whereas BMI of 30 or greater is "obese."

approximately 5,000 persons per year. One unique characteristic of NHANES is that it includes both an interview and a physical exam. At the time of the interview, medical professionals administer the physical exams and collect extensive health information from survey respondents, including height and weight. Therefore, the findings from NHANES are considered to be national standards for measurements such as height and weight.[8]

The averages for height, weight, and body mass index (BMI) of the entire sample in FoodAPS are not statistically different from those in NHANES.[9] The distribution of children's adiposity in FoodAPS, on the other hand, differs significantly from that in NHANES (app. table 1). FoodAPS tends to overestimate the rate of obesity for the youngest group and underestimate it for the oldest group. For example, the proportion of obese children age 2-5 is 26.4 percent in FoodAPS, versus 8.4 percent in NHANES. Meanwhile, the proportion of obese children age 12-19 is 13.9 percent in FoodAPS, versus 20.5 percent in NHANES. This is consistent with the findings from Akinbami and Ogden (2009) and Weden et al. (2013), who note that parent-reported obesity rates tend to suffer from an upward bias for young children and a downward bias for older children. Parents tend to underreport their younger children's heights and older children's weights, leading to overestimation of obesity rates for the former and the opposite for the latter.[10] This seems to be the case in FoodAPS, where the primary respondent underreported younger children's height and older children's weight.[11]

To correct for the measurement error in parent-reported heights of young children, this ERS study employs the method similar to that used in Cawley (2004). Cawley (2004) uses the relationship between the measured and the reported heights and weights in NHANES to correct for the errors in self-reported information among adults. However, NHANES collected only measured heights and weights for children and not parent-reported heights and weights. Therefore, heights are predicted, assuming that the reported weights in FoodAPS are close to the actual weights, at least for young children. Such an assumption is reasonable because (1) studies show that parents tend to misreport young children's heights but not their weights (Akinbami and Ogden, 2009; Weden et al., 2013) and (2) the reported weights of young children in FoodAPS are close to the population average in NHANES.

The heights of young children in FoodAPS are corrected using the following steps. First, measured heights of children age 2-5 are regressed on their demographic characteristics and measured weight using NHANES. Then, children's height in FoodAPS is predicted using the estimated coefficients. Approximately half of the sample children age 2-5 in FoodAPS are

[8] For more information on NHANES, see the Centers for Disease Control and Prevention website.

[9] According to Clay et al. (2016), the average weight of respondents in both surveys is 157 pounds and the average height is 64 inches. The average rate of obesity is similar across both surveys (28 percent in FoodAPS versus 26 percent in NHANES), but the average rate of overweight is slightly higher in FoodAPS (30 percent) relative to NHANES (25 percent).

[10] Since body mass index (BMI) is calculated by dividing weight by height, underreporting of height leads to overestimation of BMI and, consequently, obesity rates. On the other hand, underreporting of weight leads to underestimation of BMI and obesity rates.

[11] The differences in height and weight between FoodAPS and NHANES reaffirm the findings from Weden et al. (2013). The underreporting of children's height by a parent declines with children's age. On the other hand, the underreporting of children's weight by a parent increases with children's age. The table is available upon request.

affected by the correction. The resulting rates of overweight and obesity are much closer to the population estimates from NHANES (see app. table 2). The estimates are mostly within the range of 95-percent confidence intervals presented in Ogden et al. (2014). In addition, the overall trends by race, sex, and age groups are consistent with those in NHANES.[12]

As an alternative, the Child Supplement of the National Longitudinal Survey of Youth 79 (NLSY-CH) is used to correct for bias. For some observations between 2006 and 2014, NLSY-CH collected both mother-reported and measured heights and weights of children. Using the relationship between mother-reported and measured information in NLSY-CH, this study corrected the heights and weights in FoodAPS (see app. table 2).[13] The resulting rates of overweight and obesity were significantly different from the estimates in NHANES. The difference could be driven by the fact that NLSY-CH is not nationally representative since (1) only the information on children of the original NLSY 79 respondents was collected, and (2) only a subsample of children had both mother-reported and measured information. Therefore, this study uses the NHANES adjusted data for the analysis.

## Household characteristics

FoodAPS collected extensive information on household demographic and socioeconomic characteristics, including race, age, marital status, employment status, household size, income, nonfood expenditures,[14] car ownership, home ownership, and participation status in food and nutrition assistance programs. Clay et al. (2016) find that these characteristics are consistent with those collected in other national surveys, such as the U.S. Census Bureau's Current Population Survey and the Survey of Income and Program Participation.

## Food environment

The geography component of the survey (FoodAPS-GC) collected information on a household's local food environment. Household locations are matched to the USDA Store Tracking and Redemption Subsystem and InfoUSA to determine access to food stores and dining-out places, respectively. FoodAPS provides data on measures of access to retailers and restaurants as well as measures of food prices and prices of food categories by retailers. This analysis uses household-level data on the number of food retailers within a fixed-mile radius and the distance to the nearest stores.

[12] While correcting the heights of young children results in obesity rates that are close to the measured rates in NHANES, correcting the weights of older children seems to exacerbate the bias.

[13] This ERS study first regresses measured height on mother-reported height, mother-reported height squared, mother-reported weight, and demographic characteristics (age, gender, race) using data from the Child Supplement of the National Longitudinal Survey of Youth 79. Then, it predicts young children's height in FoodAPS using the coefficients obtained. It follows the same procedure to predict the female adolescent's weight, which tends to suffer most from the measurement error (Akinbami and Ogden, 2009).

[14] The respondents reported their monthly expenditures on rent or mortgages, rental or homeowners insurance, property taxes, public transport, health insurance, health insurance co-pays, doctor and hospital bills, prescription drugs, electricity, heating fuel, sewer and garbage removal, child care, child support, and adult care.

## Food acquisition

FoodAPS collected detailed information on the types and amounts of food that households acquired during the survey week, as well as the source of acquisition (e.g., supermarket, fast-food restaurant) and the prices paid. This information was gathered using multiple methods: survey booklets complemented with phone interviews, hand-held scanners, and point-of-sale receipts. All members of FoodAPS households age 11 or older filled out a food diary for both food at home (FAH) and food away from home (FAFH). FAH comprises food acquired from stores and prepared at home. FAFH comprises restaurant meals and other foods prepared outside the home. For FAH, respondents were asked to scan items with hand-held devices and to provide store receipts. This information was later used to reconcile with self-reported information. In contrast to FAH, no FAFH items were scanned. Instead, respondents were asked to record details on the food items acquired, including prices for each item. The self-reported information was later reconciled with information from telephone interviews and receipts.

FoodAPS did not initially collect information on nutrients of acquired foods. However, survey administrators matched each recorded food item with nutrient information using scanned barcodes and product descriptions, providing an opportunity for researchers to determine the nutritional quality of food acquired by households. One way to assess the nutritional quality of a food item is to simply examine the amounts of nutrients, such as calories, carbohydrates, protein, and fat. Another way is to use a standardized measure that summarizes the various dimensions of nutritional quality. USDA's 2010 Healthy Eating Index (HEI) estimates the degree to which an individual's diet conforms to the *2010 Dietary Guidelines for Americans* issued by USDA and the U.S. Department of Health and Human Services. The index is made up of nine food groups that are recommended for consumption (e.g., fruits and vegetables) and three food groups that should be consumed in moderation (e.g., sugar). Individuals get HEI scores for each food group depending on how closely the person's diet meets the recommended levels of consumption (see box "Health Eating Index"). The total composite HEI ranges from 0 to 100, with diet quality improving as scores increase. Between 2011 and 2012, the average HEI for Americans age 2 and older was 59 (CNPP, 2016).

### Healthy Eating Index

The Healthy Eating Index (HEI) is a scoring metric for diet quality that assesses compliance with the *Dietary Guidelines for Americans*. The measure can be used to determine diet quality of individual food intake, community food environment, food processing, or national food supply (National Cancer Institute, 2017). HEI is computed based on the consumption amount per 1,000 calories of 9 recommended food groups and 3 food groups that should be consumed in moderation (Guenther et al., 2013 and 2014). The nine recommended food groups are total fruits, whole fruits, total vegetables, greens and beans, whole grains, dairy, total protein food, seafood and plant protein, and fatty acids. The three food groups that should be consumed in moderation are refined grains, sodium, and empty calories (solid fats, alcohol, and added sugars). The amount of food acquired is compared with the recommended amount for each food group and is scored based on how closely it follows the recommendation. For example, the recommended amount of fruits is 0.8 cup equivalents per 1,000 calories. Any amount larger than the recommendation will result in a maximum score of five, whereas any consumption less than the recommendation will result in a correspondingly lower score. The total composite HEI is the sum of all 12 component scores and ranges between 0 and 100.

# Differences in Household Characteristics and Food Environments Among Households With and Without Obese Children

## Demographic and socioeconomic characteristics

Children from obese-child households are more likely to be Hispanic than children from nonobese-child households (table 1). Their parents are less likely to be married or employed and are more likely to have less education and to be obese than the parents of nonobese-child households.[15] The prevalence of obese mothers (fathers) is 15 percentage points (18 percentage points) higher for obese-child households than for nonobese-child households. Among parents with only obese children, some obese children, or no obese children, those without obese children have the lowest overall BMI distribution, while those with only obese children have the highest BMI distribution (fig. 1). The high correlation between parents' and children's weights suggests that shared environments and genetic compositions (Anderson et al., 2009) may be driving an intergenerational transmission of obesity (Classen, 2010; Classen and Thompson, 2016).

Table 1
**Demographic characteristics of FoodAPS households, 2012**

| | Nonobese HH | Obese HH | Differences |
|---|---|---|---|
| Child characteristics | | | |
| Male | 0.46 | 0.52 | -0.05 |
| | (0.02) | (0.03) | (0.04) |
| Age | 9.68 | 9.98 | -0.31 |
| | (0.24) | (0.23) | (0.27) |
| Hispanic | 0.19 | 0.29 | -0.10*** |
| | (0.03) | (0.05) | (0.04) |
| Non-Hispanic Black | 0.14 | 0.15 | -0.01 |
| | (0.03) | (0.03) | (0.03) |
| Household characteristics | | | |
| Mother's age | 38.04 | 37.32 | 0.72 |
| | (0.41) | (0.43) | (0.59) |
| Married | 0.76 | 0.62 | 0.14*** |
| | (0.02) | (0.04) | (0.04) |
| Mother: high school or less | 0.17 | 0.25 | -0.08 |
| | (0.02) | (0.05) | (0.05) |
| Mother: some college | 0.40 | 0.32 | 0.08** |
| | (0.03) | (0.04) | (0.03) |
| Mother: college and higher | 0.35 | 0.23 | 0.12*** |
| | (0.03) | (0.04) | (0.04) |
| Mother: employed | 0.63 | 0.60 | 0.03 |

—continued

[15] The main findings remain consistent, even when households with at least one overweight or obese child are compared with households without any such children.

Table 1
**Demographic characteristics of FoodAPS households, 2012—continued**

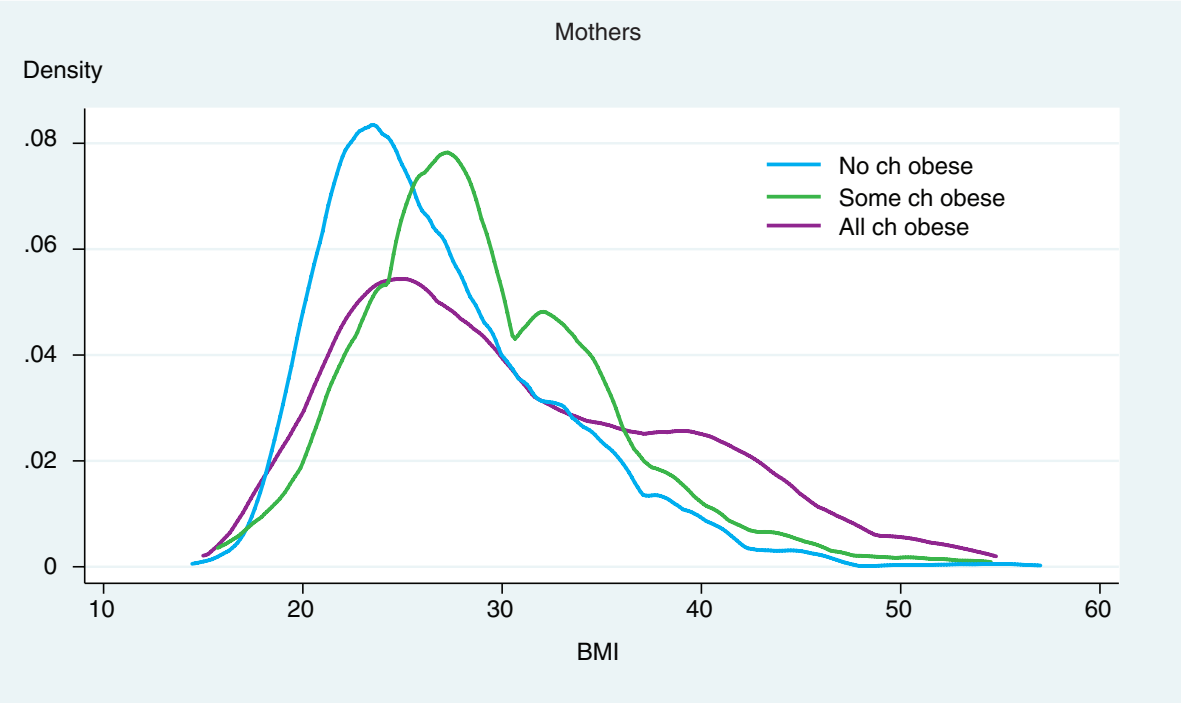
| | Nonobese HH | Obese HH | Differences |
|---|---|---|---|
| | (0.03) | (0.04) | (0.05) |
| Mother: overweight | 0.30 | 0.34 | -0.04 |
| | (0.02) | (0.05) | (0.06) |
| Mother: obese | 0.27 | 0.42 | -0.15** |
| | (0.02) | (0.05) | (0.06) |
| Father's age | 40.59 | 39.79 | 0.80 |
| | (0.49) | (0.61) | (0.80) |
| Father: high school or less | 0.28 | 0.35 | -0.08 |
| | (0.03) | (0.05) | (0.06) |
| Father: some college | 0.26 | 0.19 | 0.07 |
| | (0.03) | (0.04) | (0.05) |
| Father: college and higher | 0.38 | 0.21 | 0.17** |
| | (0.04) | (0.04) | (0.07) |
| Father: employed | 0.93 | 0.87 | 0.06** |
| | (0.01) | (0.03) | (0.03) |
| Father: overweight | 0.52 | 0.40 | 0.12** |
| | (0.03) | (0.05) | (0.05) |
| Father: obese | 0.25 | 0.43 | -0.18*** |
| | (0.03) | (0.05) | (0.05) |
| Rural | 0.38 | 0.32 | 0.06 |
| | (0.04) | (0.06) | (0.06) |
| Household size | 4.58 | 5.31 | -0.73*** |
| | (0.12) | (0.27) | (0.26) |
| Number of children less than 18 yrs. old | 2.25 | 2.73 | -0.49** |
| | (0.11) | (0.21) | (0.21) |

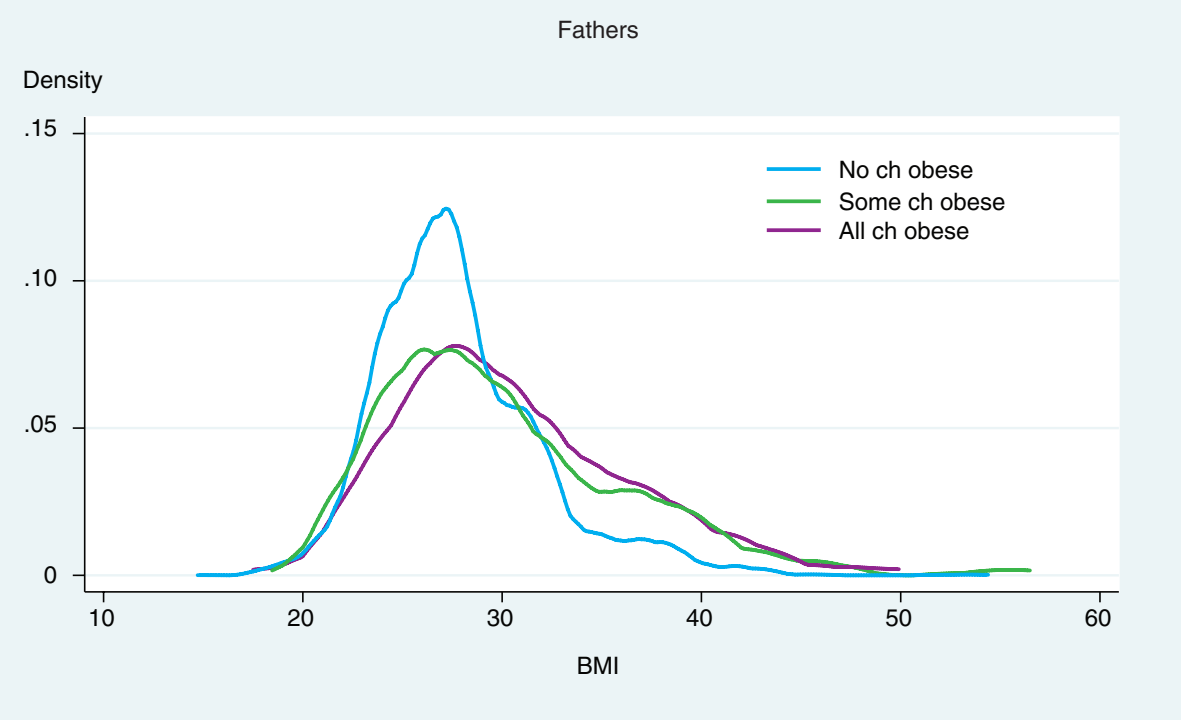
Notes: ** p<0.1 ** p<0.05 *** p<0.001*. Averages using sample weights are reported in this table. Standard errors are clustered at the household level and are reported in parentheses. The sample consists of children age 2-17. "Obese HH" = households with at least one obese child, and "nonobese HH" = households without any obese children.

Source: USDA, Economic Research Service using data from USDA's National Household Food Acquisition and Purchase Survey (FoodAPS), 2012.

Figure 1

**Body mass index (BMI) distribution of parents in FoodAPS households, 2012**



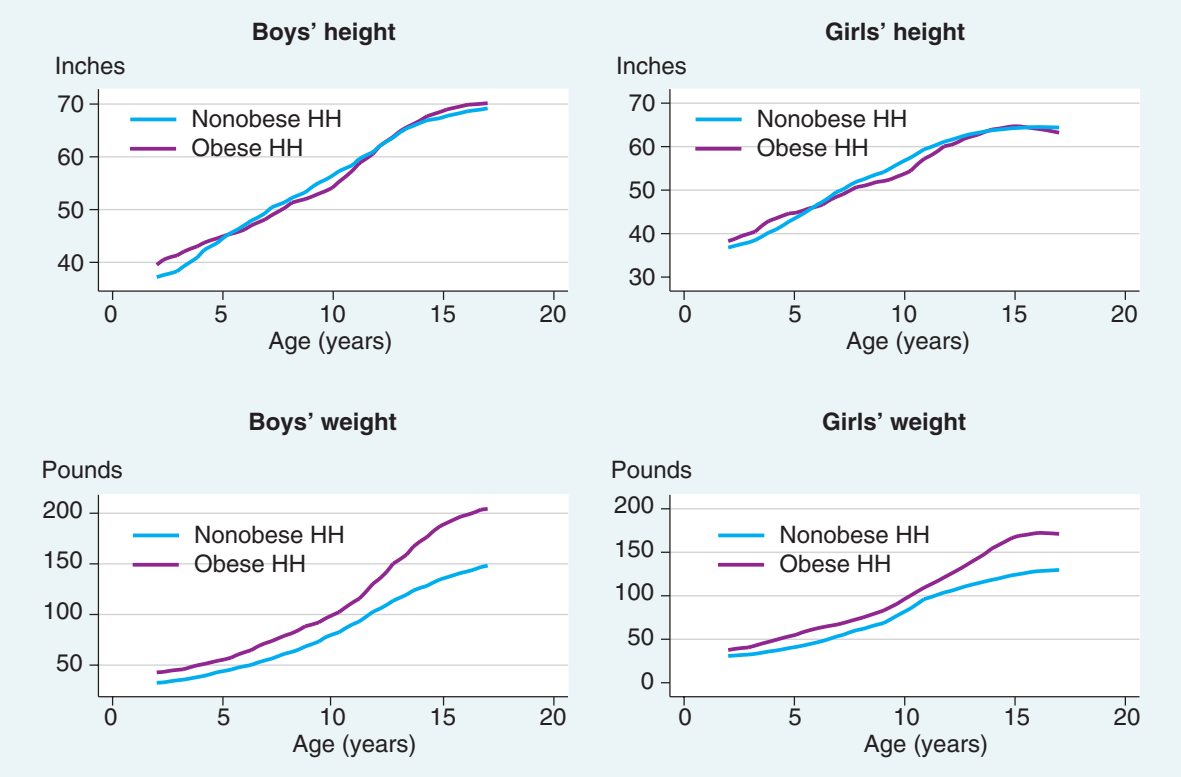




Notes: The sample consists of mothers and fathers of children reported in the survey. "All ch obese" = households where all of the children are obese, "Some ch obese" = households where some of the children are obese, and "No ch obese" = households without any obese children. The sample excludes observations with unrealistically high or low BMI. The figure shows the distribution of BMI of the particular sample.

Source: USDA, Economic Research Service using data from USDA's National Household Food Acquisition and Purchase Survey (FoodAPS), 2012.

Financial well-being can shape a household's environment and affect the cognitive and noncognitive development of children in the household (Case et al., 2002; Dahl and Lochner, 2012; Jo, 2016).[16] Previous research shows that children from low-income households have a higher risk of obesity (Anderson and Butcher, 2006; Jo, 2014; Lin, 2005; Murasko, 2009 and 2013). Low-income households may be able to afford only relatively cheap processed foods, which have low nutritional values and high calories (Aggarwal et al., 2012; Drewnowski, 2010; Townsend et al., 2009). These household types likely live in unsafe neighborhoods where children cannot play outside, and they typically lack the resources needed to send children to sports and other afterschool programs, resulting in lower calorie expenditure for the children. The faster weight gain of children from obese-child households, rather than a stunted height growth, accounts for the difference in obesity rates of children (fig. 2).

Figure 2
**Height and weight distribution of children in FoodAPS households, 2012**




Notes: The sample consists of children age 2-17. "Obese HH" = households with at least one obese child, and "nonobese HH" = households without any obese children. The figure demonstrates that heights do not differ between children from the two household types but weights do, especially at later ages.

Source: USDA, Economic Research Service using data from USDA's National Household Food Acquisition and Purchase Survey (FoodAPS), 2012.

Obese-child households are financially worse off than nonobese-child households (table 2). They have lower monthly incomes, are less likely to own a house or a car, and own fewer numbers of cars,

[16] Studies show that financial resources play a crucial role on children's cognitive development. For example, Dahl and Lochner (2012) find that additional household income can increase children's test scores by improving parents' emotional well-being, which subsequently encourages them to nurture children better. Additional income also enables parents to purchase more child-centered goods, such as books or quality day care, directly influencing children's cognitive development. Household income also protects children from getting sick and helps them recover faster when they do get sick (Currie and Stabile, 2003; Condliffe and Link, 2008).

on average, than nonobese-child households. Among the two household types, a higher share of obese-child households participates in or has participated in SNAP.[17] Given that obese-child households are no more likely than nonobese-child households to live in rural areas—where the cost of living is lower—and have more household members (see table 1), the lower nonfood expenditures per household member of obese-child households probably implies that their financial resources are relatively limited.

Table 2
**Financial well-being of FoodAPS households, 2012**

| | Nonobese HH | Obese HH | Differences |
|---|---|---|---|
| Household monthly income ($) | 6,571.00 | 4,608.00 | 1,963.54*** |
| | (380.90) | (287.30) | (374.96) |
| Urban | 4,350.24 | 3,370.09 | 983.36*** |
| | (113.06) | (105.13) | (172.05) |
| Rural | 4,718.39 | 3,317.64 | 1,400.75*** |
| | (170.03) | (141.02) | (266.34) |
| Monthly nonfood expenditures per person ($) | 459.40 | 329.70 | 129.65*** |
| | (22.72) | (21.16) | (26.33) |
| Urban | 343.91 | 253.31 | 89.65*** |
| | (8.59) | (6.73) | (12.68) |
| Rural | 304.89 | 239.39 | 65.50*** |
| | (11.95) | (12.01) | (19.29) |
| Own or lease a car (%) | 0.95 | 0.90 | 0.05** |
| | (0.01) | (0.02) | (0.02) |
| Urban | 0.86 | 0.84 | 0.02 |
| | (0.01) | (0.01) | (0.02) |
| Rural | 0.95 | 0.91 | 0.04* |
| | (0.01) | (0.02) | (0.02) |
| Number of cars owned | 2.14 | 1.98 | 0.16 |
| | (0.06) | (0.12) | (0.11) |
| Urban | 1.63 | 1.61 | 0.03 |
| | (0.03) | (0.04) | (0.05) |
| Rural | 2.23 | 2.1 | 0.14 |
| | (0.06) | (0.09) | (0.10) |
| Own a house (%) | 0.62 | 0.49 | 0.13*** |
| | (0.03) | (0.04) | (0.04) |
| Urban | 0.39 | 0.30 | 0.08*** |
| | (0.01) | (0.02) | (0.02) |
| Rural | 0.62 | 0.60 | 0.02 |

—continued

[17] The higher rate of SNAP participation among obese-child households raises the question of whether participation in SNAP causes weight gain. However, the findings on the effect of SNAP on weight gain are ambiguous. While SNAP seems to increase BMI and obesity rates of female adults (Gibson, 2003; Ver Ploeg and Ralston, 2008), it seems to reduce those of children (Kreider et al., 2012; Schmeiser, 2012).

Table 2
**Financial well-being of FoodAPS households, 2012—continued**

| | Nonobese HH | Obese HH | Differences |
|---|---|---|---|
| | (0.02) | (0.03) | (0.04) |
| Participate in SNAP (%) | 0.33 | 0.44 | -0.11** |
| | (0.02) | (0.04) | (0.04) |
| Urban | 0.58 | 0.67 | -0.09*** |
| | (0.01) | (0.02) | (0.02) |
| Rural | 0.55 | 0.66 | -0.11** |
| | (0.02) | (0.03) | (0.04) |

Notes: ** p<0.1 ** p<0.05 *** p<0.001*. Averages using sample weights are reported in this table. Standard errors are clustered at the household level and are reported in parentheses. "Obese HH" = households with at least one obese child, and "non-obese HH" = households without any obese children. SNAP = Supplemental Nutrition Assistance Program.

Source: USDA, Economic Research Service using data from USDA's National Household Food Acquisition and Purchase Survey (FoodAPS), 2012.

Because the characteristics of households in rural areas likely differ from those of households in urban areas, the financial well-being of households with and without obese children is examined separately here for rural and urban areas (see table 2). The difference in monthly household income between obese-child households and nonobese-child households is greater in rural areas ($1,401) than in urban areas ($983). On the other hand, the difference in monthly nonfood expenditures per household member is lower in rural areas ($66) than in urban areas ($90). Having access to a car is more important for households in rural areas, where public transportation is not as widely available as it is in urban areas and food stores are sparsely located. In rural areas, most households own or lease a car (above 90 percent), but nonobese-child households are 4 percentage points more likely to own or lease a car than obese-child households. The difference in car accessibility across the household types is not statistically significant in urban areas. Differences in car access suggest that households may also exhibit differences in food access.

## Food environment

A growing number of studies have examined the effects of local environments on obesity rates. Some studies focus on the relationship between environments that lack stores or restaurants offering healthful food options, commonly known as food deserts, and the poor diet quality and weight status of local residents. Others focus on the relationship between the abundance of stores or restaurants selling unhealthful foods—such as fast-food restaurants or convenience stores—and obesity rates. Food prepared away from home generally contains more calories, is served in larger portion sizes, and is less nutritious (e.g., high in fat and sodium) than food prepared at home (Guthrie et al., 2002; Mancino et al., 2010; Nielsen and Popkin, 2003). Therefore, easier access to (short distance to the nearest food outlet) or greater availability of (high density of food outlets within a radius) stores or restaurants selling unhealthful foods can increase the net caloric intake of local residents, eventually leading to high obesity rates (Mancino et al., 2014).

Results from these studies are mixed. Some find that a high density of stores or restaurants selling healthful foods is associated with a lower risk of obesity (Carroll-Scott et al., 2013; Harrison et al., 2011; Zick et al., 2009). Others find that a high density of fast-food restaurants is associated with high obesity rates in the surrounding areas (Alviola et al., 2014; Chen et al., 2013; Currie et al.,

2010; Dunn, 2010; Dunn et al., 2012). For example, Alviola et al. (2014) show that in Arkansas, the addition of a fast-food restaurant within a 1-mile radius of a school raises obesity rates of children attending the school by 1.23 percentage points. Currie et al. (2010) find that children attending schools within 0.1 miles of a fast-food restaurant have a higher obesity rate (1.7 percentage points) than children attending schools within 0.10 to 0.25 miles of a fast-food restaurant. In contrast, other studies find that the proximity to stores or restaurants has a negligible effect on where people shop (Ver Ploeg et al., 2015) or how much they weigh (Lee, 2012; Lopez, 2007; Sturm and Hattori, 2015; Wang et al., 2007).

Households in rural areas, where food stores are sparsely located, face distinctly different food environments than households in urban areas. Rural households are more likely to have access to cars and travel further to shop or dine out than urban households. The differences are more pronounced for rural households with obese children. On average, rural obese-child households have 0.9 and 2.8 fewer superstores within a 10- and 15-mile radius, respectively, than rural nonobese-child households (table 3). Rural obese-child households also have 1.3 and 2.9 fewer supermarkets within a 10- and 15-mile radius, respectively, than rural nonobese households. Although rural obese-child households seem to live further from the nearest stores and restaurants than rural nonobese-child households, the differences are not statistically significant, except for the distance to the nearest sit-down restaurant (0.6 miles further for rural obese-child households). In summary, rural obese-child households live in areas with lower access to superstores and supermarkets than rural nonobese-child households. Given that households without access to cars depend more on nearby stores (Clifton, 2004) and that a lower percentage of obese-child households in rural areas has access to cars (see table 2), the actual difference in food accessibility between the two types of rural households is likely to be greater.

Table 3
**Household food environment: rural areas, 2012**

| | Nonobese HH | Obese HH | Differences |
|---|---|---|---|
| Number of super stores within 10 miles | 4.4 | 3.5 | 0.9* |
| | (0.2) | (0.3) | (0.4) |
| Number of super stores within 15 miles | 11.6 | 8.8 | 2.8* |
| | (0.7) | (0.8) | (1.1) |
| Number of supermarkets within 10 miles | 5.8 | 4.5 | 1.3* |
| | (0.4) | (0.4) | (0.6) |
| Number of supermarkets within 15 miles | 13.6 | 10.7 | 2.9* |
| | (0.8) | (1.0) | (1.4) |
| Number of convenience stores within 10 miles | 17.0 | 15.1 | 1.9 |
| | (0.8) | (1.0) | (1.3) |
| Number of convenience stores within 15 miles | 43.6 | 37.6 | 6.0 |
| | (2.1) | (2.7) | (3.6) |
| Number of fast-food restaurants within 10 miles | 24.9 | 22.1 | 2.8 |
| | (1.4) | (2.0) | (2.5) |
| Number of fast-food restaurants within 15 miles | 52.0 | 47.7 | 4.3 |
| | (2.9) | (4.6) | (5.3) |
| Number of sit-down restaurants within 10 miles | 91.7 | 72.5 | 19.2 |

—continued

Table 3
**Household food environment: rural areas, 2012—continued**

| | Nonobese HH | Obese HH | Differences |
|---|---|---|---|
| | (5.9) | (7.3) | (10.0) |
| Number of sit-down restaurants within 15 miles | 190.9 | 163.8 | 27.1 |
| | (11.7) | (17.8) | (21.0) |
| Distance to the nearest super store (miles) | 5.7 | 6.3 | -0.6 |
| | (0.2) | (0.3) | (0.4) |
| Distance to the nearest supermarket (miles) | 5.4 | 6.0 | -0.6 |
| | (0.2) | (0.4) | (0.5) |
| Distance to the nearest convenience store (miles) | 3.1 | 3.4 | -0.2 |
| | (0.1) | (0.2) | (0.2) |
| Distance to the nearest fast-food restaurant (miles) | 4.3 | 5.0 | -0.7 |
| | (0.2) | (0.3) | (0.3) |
| Distance to the nearest sit-down restaurant (miles) | 1.9 | 2.5 | -0.6*** |
| | (0.1) | (0.2) | (0.2) |

Notes: ** p<0.1 ** p<0.05 *** p<0.001*. Averages using sample weights are reported in this table. Standard errors are clustered at the household level and are reported in parentheses. "Obese HH" = households with at least one obese child, and "non-obese HH" = households without any obese children.

Source: USDA, Economic Research Service using data from USDA's National Household Food Acquisition and Purchase Survey (FoodAPS), 2012.

Table 4 follows a similar approach to table 3 but instead examines food environments in urban areas and uses a shorter radius between food stores and households. Consistent with Powell et al. (2007), urban obese-child households live in areas with a greater availability of and access to convenience stores than urban nonobese-child households. Urban obese-child households have 0.4 and 0.8 more convenience stores within a 0.5- and a 1.0-mile radius, respectively, than urban nonobese-child households. In addition, the distances to the nearest convenience store are 0.2 miles shorter for urban obese-child households than for urban nonobese-child households.[18] In contrast to studies that find a large number of fast-food restaurants being associated with high obesity rates, this study finds no difference in the availability of and access to fast-food restaurants for the two household types in urban areas.

Table 4
**Household food environment: urban areas, 2012**

| | Nonobese HH | Obese HH | Differences |
|---|---|---|---|
| Number of super stores within 0.5 mile | 0.3 | 0.3 | -0.0 |
| | (0.0) | (0.0) | (0.0) |
| Number of super stores within 1 mile | 1.0 | 1.1 | -0.1* |
| | (0.0) | (0.0) | (0.1) |

—continued

[18] Urban obese-child households have more superstores within a 1.0-mile radius than urban nonobese-child households, but the difference (0.1) is small.

Table 4
**Household food environment: urban areas, 2012—continued**

| | Nonobese HH | Obese HH | Differences |
|---|---|---|---|
| Number of supermarkets within 0.5 mile | 0.3 | 0.3 | -0.0 |
| | (0.0) | (0.0) | (0.0) |
| Number of supermarkets within 1 mile | 1.1 | 1.1 | 0.0 |
| | (0.0) | (0.0) | (0.1) |
| Number of convenience stores within 0.5 mile | 1.9 | 2.3 | -0.4** |
| | (0.1) | (0.1) | (0.1) |
| Number of convenience stores within 1 mile | 6.3 | 7.1 | -0.8* |
| | (0.2) | (0.3) | (0.4) |
| Number of fast-food restaurants within 0.5 mile | 2.1 | 2.1 | 0.0 |
| | (0.1) | (0.1) | (0.1) |
| Number of fast-food restaurants within 1 mile | 7.2 | 7.5 | -0.3 |
| | (0.2) | (0.2) | (0.3) |
| Number of sit-down restaurants within 0.5 mile | 10.1 | 9.9 | 0.3 |
| | (0.6) | (0.7) | (0.9) |
| Number of sit-down restaurants within 1 mile | 31.7 | 31.6 | 0.1 |
| | (1.4) | (1.7) | (2.2) |
| Distance to the nearest super store (miles) | 1.3 | 1.3 | 0.0 |
| | (0.0) | (0.1) | (0.1) |
| Distance to the nearest supermarket (miles) | 1.5 | 1.1 | 0.4** |
| | (0.1) | (0.1) | (0.1) |
| Distance to the nearest convenience store (miles) | 0.7 | 0.5 | 0.2*** |
| | (0.0) | (0.0) | (0.0) |
| Distance to the nearest fast-food restaurant (miles) | 0.6 | 0.6 | 0.0 |
| | (0.0) | (0.0) | (0.0) |
| Distance to the nearest sit-down restaurant (miles) | 0.4 | 0.3 | 0.0* |
| | (0.0) | (0.0) | (0.0) |

Notes: ** p<0.1 ** p<0.05 *** p<0.001*. Averages using sample weights are reported in this table. Standard errors are clustered at the household level and are reported in parentheses. "Obese HH" = households with at least one obese child, and "non-obese HH" = households without any obese children.

Source: USDA, Economic Research Service using data from USDA's National Household Food Acquisition and Purchase Survey (FoodAPS), 2012.

The findings in this section suggest that obese-child households live in areas with lower access to healthful foods. Superstores or supermarkets tend to consistently carry healthful foods, such as fresh produce and low-fat protein. Convenience stores tend to carry mostly nonperishable processed foods with a long shelf life, such as sugary drinks and salty snacks. As shown in tables 3 and 4, obese-child households have access to fewer superstores and supermarkets (in rural areas) and more convenience stores (in urban areas) than nonobese-child households. However, these findings should be interpreted with caution. Members of some households may occasionally shop for food or dine out near their workplaces or commuting paths. Therefore, although the households may be located in areas with lower access to healthful foods, their actual access to healthful foods may not be low.

Moreover, individuals with high body weight may prefer to live in areas with a greater availability of stores selling unhealthful foods. In such cases, there would be an association between the number of stores selling unhealthful foods and the residents' weight status, but the relationship cannot be deemed causal.[19]

## Food consumption patterns

Parents have a large influence on their children's physical and emotional well-being. Parental behaviors or household routines—such as having rules for watching TV, how often children eat, and how often the family eats together—affect children's diet and health (Anderson, 2012; Case and Paxson, 2002). Findings from some studies suggest that food consumption patterns, in particular, are an important mechanism behind the adverse impact of maternal employment on childhood obesity. For example, Cawley and Liu (2012) find that working mothers spend less time cooking and eating with children and are more likely to buy prepared foods than nonworking mothers. Fiese et al. (2012) note that households with normal-weight children are more likely to value shared meal times than households with overweight children. Therefore, where children eat (at home or at a restaurant), how often a household eats together, and how frequently children eat throughout the day can all be important correlates with body weights.

Food consumption patterns do not differ significantly between households with and without an obese child (table 5). Given that restaurant meals tend to be higher in calories and less nutritious than meals prepared at home, one would expect obese-child households to eat at restaurants more frequently than nonobese-child households. However, the difference in the number of times the two household types ate dinner out or at home is not statistically significant. Nor is the difference in the number of times the household types ate dinner together as families—an activity that enables parents to closely monitor their children's diets. The only statistically significant difference in food consumption patterns is the number of times children ate breakfast.[20] During the survey week, children from nonobese-child households ate breakfast 5 percent more often than children from obese-child households. The number of times children consumed other meals (lunch, dinner, and snacks) is consistent across the household types.

Table 5
**Food consumption patterns of FoodAPS households, 2012**

| | Nonobese HH | Obese HH | Differences |
|---|---|---|---|
| Number of times HH ate dinner out per week | 1.2 | 1.1 | 0.1 |
| | (0.1) | (0.1) | (0.1) |
| Number of times HH prepared dinner at home per week | 5.2 | 5.5 | -0.2 |
| | (0.1) | (0.2) | (0.2) |

—continued

[19] The main issue here is that the location of retail food stores is not randomly chosen. Business owners open stores in areas with high demand, and overweight individuals may prefer to reside in areas with a high density of convenience stores and fast-food restaurants. Thus, we need to separate the supply of stores from demand to identify the causal effect. A growing number of researchers use econometric strategies to identify the causal effect of fast-food restaurants and grocery stores on obesity (Courtemanche and Carden, 2011; Dunn, 2010; Dunn et al., 2012).

[20] This is consistent with Fertig et al. (2009), who find that the share of meals children eat at restaurants is not significantly correlated with their BMIs, but the number of meals children eat is significantly and negatively associated with their BMIs.

Table 5
**Food consumption patterns of FoodAPS households, 2012—continued**

| | Nonobese HH | Obese HH | Differences |
|---|---|---|---|
| Number of times HH ate dinner together per week | 5.6 | 5.8 | -0.2 |
| | (0.1) | (0.2) | (0.2) |
| Number of times child ate breakfast per week | 5.8 | 5.5 | 0.4* |
| | (0.1) | (0.2) | (0.2) |
| Number of times child ate lunch per week | 6.1 | 6.1 | -0.0 |
| | (0.1) | (0.1) | (0.2) |
| Number of times child ate dinner per week | 6.3 | 6.3 | 0.0 |
| | (0.1) | (0.1) | (0.1) |
| Number of times child ate snack per week | 13.0 | 12.6 | 0.4 |
| | (0.3) | (0.5) | (0.5) |

Notes: ** p<0.1 ** p<0.05 *** p<0.001*. Averages using sample weights are reported in this table. Standard errors are clustered at the household level and are reported in parentheses. "Obese HH" = households with at least one obese child, and "non-obese HH" = households without any obese children.

Source: USDA, Economic Research Service using data from USDA's National Household Food Acquisition and Purchase Survey (FoodAPS), 2012.

The findings in this section have a number of caveats. First, the number of times a child eats breakfast may simply be associated with other household routines that are beneficial for children's weight. For example, parents who are concerned about their children's weight may not only make sure the children do not skip a meal but may also take them out more often for physical activities. In addition, the lack of a statistically significant correlation between the number of times households eat out and childhood obesity may be driven by incomplete information. FoodAPS did not collect information on whether a child actually ate anything when a household ate at home or at a restaurant. Fertig et al. (2009) propose that takeout meals eaten at home may be obscuring the significant effect of eating at a restaurant. Lastly, FoodAPS did not collect information on the number of times a household ate meals outside the home other than dinner. Although dinner may be the meal that a household is most likely to consume at a restaurant, the lack of information on breakfast or lunch consumption away from home may be masking potential differences across household types.

## Nutritional quality of the food baskets and attitude toward healthy eating

The nutritional quality of food acquired by FoodAPS households may account for significant differences between households with and without an obese child (table 6). Previous studies find that a person's knowledge of diet and nutrition is closely related to his or her diet quality (Blaylock et al., 1999; Gregory et al., 2014; Park et al., 2014; Wardle et al., 2000). Parents from obese-child households, who tend to have lower income and education levels than parents from nonobese-child households, may have limited knowledge of nutritious foods or healthful cooking (Variyam et al., 1998 and 1999). As a result, children from these households may consume less nutritious and high-caloric meals.

Table 6
**Nutritional quality of food baskets acquired by FoodAPS households, 2012**

| | Total | | | Food at home | | | Food away from home | | |
|---|---|---|---|---|---|---|---|---|---|
| | Non-obese HH | Obese HH | Differences | Non-obese HH | Obese HH | Differences | Non-obese HH | Obese HH | Differences |
| Additional calories acquired per household[1] | -143.9 | -414.6 | 270.7 | | | | | | |
| | (450.3) | (424.1) | (603.9) | | | | | | |
| Daily amount of nutrients acquired per SAE in grams[2] | | | | | | | | | |
| Protein | 60.8 | 58.6 | 2.2 | 39.8 | 39.6 | 0.2 | 21.0 | 19.0 | 2.0 |
| | (2.0) | (3.4) | (4.0) | (1.8) | (3.4) | (3.8) | (0.8) | (1.4) | (1.6) |
| Dietary fiber | 14.4 | 14.2 | 0.3 | 10.6 | 10.8 | -0.1 | 3.8 | 3.4 | 0.4 |
| | (0.5) | (1.1) | (1.2) | (0.5) | (1.2) | (1.2) | (0.1) | (0.3) | (0.3) |
| Sugar | 127.9 | 128.9 | -1.0 | 100.0 | 100.5 | -0.5 | 27.9 | 28.4 | -0.5 |
| | (8.1) | (7.9) | (11.8) | (8.0) | (8.3) | (12.2) | (1.4) | (2.2) | (2.5) |
| Fat | 74.9 | 72.2 | 2.7 | 53.0 | 52.6 | 0.4 | 21.9 | 19.6 | 2.3 |
| | (2.7) | (4.9) | (5.4) | (2.6) | (4.8) | (5.2) | (0.8) | (1.5) | (1.8) |
| Added sugar | 21.8 | 22.3 | -0.5 | 17.0 | 17.4 | -0.5 | 4.8 | 4.9 | -0.0 |
| | (1.7) | (1.8) | (2.5) | (1.7) | (1.8) | (2.6) | (0.3) | (0.4) | (0.5) |

Notes: ** p<0.1 ** p<0.05 *** p<0.001*. Averages using sample weights are reported in this table. Standard errors are clustered at the household level and are reported in parentheses. "Obese HH" = households with at least one obese child, and "non-obese HH" = households without any obese children.

[1] The total daily calories acquired by households are subtracted from the total daily calories recommended by the *2010 Dietary Guidelines for Americans*. The calories are aggregated at the household level because FoodAPS does not provide information on how food was distributed among household members.

[2] All of the nutrient values represent how much a household member acquired per day on average in grams. The amount acquired per person is computed using the number of standard adult equivalents (SAE) instead of the number of household members. SAE takes into consideration differing nutrient needs by gender and age and thus accounts for potentially different household compositions across the comparison groups. For example, the total daily caloric needs for a three-member household with an adult male (2,400 kcal), an adult female (1,800 kcal), and a boy age 4 (1,200 kcal) is 5,400 kcal per day and is assigned an SAE of 2.7. The daily amount of nutrients acquired by a household is then divided by 2.7 instead of 3.0 to obtain the "per SAE acquisition amount."

Source: USDA, Economic Research Service using data from USDA's National Household Food Acquisition and Purchase Survey (FoodAPS), 2012.

A simple comparison of the total calories and nutrients acquired by a household with three adults and a household with one adult and two children will present spurious differences because adults generally need more calories and nutrients. Therefore, the amount of calories and nutrients shown in table 6 is standardized to account for varying household sizes and compositions. More specifically, the table presents the surplus calorie amount that a household acquired above the amount recommended by the *2010 Dietary Guidelines for Americans*. The amount of nutrients is standardized by the standard adult equivalent (SAE) with recommended intake of 2,000 kilocalories (kcal) per day. For example, a household with an adult male (2,400 kcal), an adult female (1,800 kcal), a 5-year-old girl (1,200 kcal), and a 10-year-old girl (1,400 kcal) requires total daily intake of 6,800 kcal and is assigned an SAE of 3.4 (6,800 divided by 2,000). The total amount of daily nutrients acquired by a

household is then divided by 3.4 instead of 4.0 to obtain the "per SAE acquisition amount in grams." Table 6 also presents the daily amount of nutrients acquired for FAH and FAFH, as the quality of nutrients likely differs depending on where food is prepared. As stated in the previous section, FAFH is generally less nutritious than FAH (Guthrie et al., 2002; Mancino et al., 2010; Nielsen and Popkin, 2003).

During the survey week, both types of households acquired less calories than the daily recommended amount (see table 6).[21] Perhaps the households already had existing stocks of food at home and thus acquired less than the recommended amount. The obese-child households acquired less calories than the nonobese-child households, even though the difference is not statistically significant. The nonobese-child households acquired slightly more protein per person (2.2 grams) but also more fat per person (2.7 grams). The differences in the amount of nutrients acquired are mostly driven by FAFH but are not statistically significant.

USDA's Healthy Eating Index is used to examine how closely a household's acquisition of nutrients adheres to the *2010 Dietary Guidelines for Americans* overall. The difference in total HEI scores between household types is small and not statistically significant (table 7). The total HEI score for nonobese-child households is 50.1, compared with 49.6 for obese-child households. Considering that the average HEI was 59.0 in NHANES, a nationally representative survey, the overall nutritional quality of food acquired by FoodAPS households is slightly lower than that of the general population. Most of the differences in individual nutrient component scores are small and not statistically significant, except for the seafood and plant protein category. For this component, scores for nonobese-child households are 1.8 out of a maximum of 5.0, compared with scores of 1.5 for obese-child households. The difference (0.3) is driven by the difference in acquisition of FAFH.

Table 7
**Healthy Eating Index (HEI) scores of food baskets acquired by FoodAPS households, 2012**

| | Total | | |
|---|---|---|---|
| HEI component (max. score) | Nonobese HH | Obese HH | Differences |
| Total vegetables (5) | 2.9 | 2.9 | 0.0 |
| | (0.1) | (0.1) | (0.1) |
| Greens and beans (5) | 1.7 | 1.8 | -0.0 |
| | (0.1) | (0.2) | (0.1) |
| Total fruit (5) | 2.3 | 2.4 | -0.1 |
| | (0.1) | (0.2) | (0.2) |
| Whole fruit (5) | 2.7 | 2.7 | 0.1 |
| | (0.1) | (0.1) | (0.2) |
| Whole grains (10) | 2.2 | 1.8 | 0.4 |
| | (0.1) | (0.3) | (0.2) |
| Dairy (10) | 6.1 | 6.2 | -0.0 |
| | (0.1) | (0.2) | (0.3) |
| Total protein foods (5) | 3.9 | 4.0 | -0.1 |

—continued

[21] The *2010 Dietary Guidelines for Americans* provides caloric requirement that varies by age and gender. The total daily calorie amounts recommended are subtracted from the total daily calorie amounts acquired by a household. The calories are aggregated at the household level because FoodAPS did not collect information on how food was distributed among household members.

Table 7
**Healthy Eating Index (HEI) scores of food baskets acquired by FoodAPS households, 2012—continued**

| HEI component (max. score) | Total | | |
|---|---|---|---|
| | Nonobese HH | Obese HH | Differences |
| | (0.0) | (0.1) | (0.1) |
| Seafood and plant proteins (5) | 1.8 | 1.5 | 0.3** |
| | (0.1) | (0.2) | (0.1) |
| Fatty acids (10) | 4.6 | 4.6 | -0.1 |
| | (0.1) | (0.2) | (0.2) |
| Sodium (10) | 5.6 | 5.9 | -0.3 |
| | (0.1) | (0.3) | (0.3) |
| Refined grains (10) | 5.6 | 5.3 | 0.3 |
| | (0.2) | (0.2) | (0.3) |
| Empty calories (20) | 10.7 | 10.6 | 0.1 |
| | (0.3) | (0.3) | (0.5) |
| Total HEI 2010 (100) | 50.1 | 49.6 | 0.5 |
| | (0.7) | (1.0) | (1.2) |

Table 7
**Healthy Eating Index (HEI) scores of food baskets acquired by FoodAPS households, 2012—continued**

| HEI component (max. score) | Food at home | | | Food away from home | | |
|---|---|---|---|---|---|---|
| | Nonobese HH | Obese HH | Differences | Nonobese HH | Obese HH | Differences |
| Total vegetables (5) | 2.6 | 2.5 | 0.1 | 0.4 | 0.5 | -0.0 |
| | (0.1) | (0.1) | (0.2) | (0.1) | (0.2) | (0.2) |
| Greens and beans (5) | 1.6 | 1.5 | 0.1 | 0.1 | 0.0 | 0.1 |
| | (0.1) | (0.2) | (0.2) | (0.1) | (0.0) | (0.1) |
| Total fruit (5) | 2.4 | 2.5 | -0.1 | 0.3 | 0.3 | 0.0 |
| | (0.1) | (0.2) | (0.2) | (0.1) | (0.1) | (0.1) |
| Whole fruit (5) | 2.7 | 2.5 | 0.2 | 0.2 | 0.3 | -0.0 |
| | (0.2) | (0.2) | (0.2) | (0.1) | (0.1) | (0.1) |
| Whole grains (10) | 2.6 | 2.1 | 0.4 | 0.2 | 0.2 | 0.0 |
| | (0.2) | (0.3) | (0.4) | (0.1) | (0.2) | (0.2) |
| Dairy (10) | 5.7 | 5.6 | 0.1 | 0.4 | 0.2 | 0.2 |
| | (0.1) | (0.3) | (0.3) | (0.1) | (0.1) | (0.1) |
| Total protein foods (5) | 3.3 | 3.3 | -0.1 | 0.6 | 0.6 | -0.1 |
| | (0.1) | (0.1) | (0.1) | (0.1) | (0.2) | (0.2) |
| Seafood and plant proteins (5) | 1.7 | 1.5 | 0.2 | 0.3 | 0.0 | 0.3*** |
| | (0.1) | (0.2) | (0.2) | (0.1) | (0.0) | (0.1) |
| Fatty acids (10) | 4.2 | 4.3 | -0.1 | 1.5 | 1.5 | -0.1 |

—continued

Table 7
**Healthy Eating Index (HEI) scores of food baskets acquired by FoodAPS households, 2012—continued**

| | Food at home | | | Food away from home | | |
|---|---|---|---|---|---|---|
| HEI component (max. score) | Nonobese HH | Obese HH | Differences | Nonobese HH | Obese HH | Differences |
| | (0.1) | (0.3) | (0.3) | (0.2) | (0.4) | (0.4) |
| Sodium (10) | 6.8 | 7.2 | -0.4 | 2.1 | 2.4 | -0.3 |
| | (0.1) | (0.3) | (0.4) | (0.3) | (0.7) | (0.7) |
| Refined grains (10) | 6.5 | 6.0 | 0.5 | 1.9 | 2.1 | -0.2 |
| | (0.2) | (0.2) | (0.3) | (0.3) | (0.6) | (0.7) |
| Empty calories (20) | 10.4 | 10.9 | -0.6 | 3.5 | 3.4 | 0.1 |
| | (0.3) | (0.5) | (0.6) | (0.5) | (1.1) | (1.3) |
| Total HEI 2010 (100) | 50.4 | 49.9 | 0.5 | 11.5 | 11.5 | 0.0 |
| | (0.9) | (1.2) | (1.5) | (1.4) | (3.1) | (3.3) |

Notes: ** p<0.1 ** p<0.05 *** p<0.001*. Averages using sample weights are reported in this table. Standard errors are clustered at the household level and are reported in parentheses. "Obese HH" = households with at least one obese child, and "non-obese HH" = households without any obese children. The table reports scores for each of the 12 components that make up the HEI and the total composite score. The maximum possible score for each component is in parenthesis. For more information on the HEI, see the USDA website.

Source: USDA, Economic Research Service using data from USDA's National Household Food Acquisition and Purchase Survey (FoodAPS), 2012.

A number of factors may explain the lack of statistically significant differences in the nutritional quality of acquired food across household types. First, some differences in nutritional quality may be obscured by the lack of data on food consumption. FoodAPS collected information on the amount of food *acquired* but not the amount *consumed*. Because of food spoilage and existing stocks of food at home, the amount consumed likely differs from the amount acquired throughout the week.[22] The implicit assumption here is that the existing stocks of food at home and the proportion of the amount consumed to the amount acquired do not vary across household types. In reality, some households may have more food at home or consume a larger share of acquired food. If obese-child households with lower incomes have a greater amount of processed food at home or consume less of the healthful foods they acquire during the week, such differences will not be detected in this analysis. Second, because the food acquisition information is self-reported, it likely suffers from some degree of error and can mask actual differences. Third, the differences in children's diet quality cannot be compared because the food acquisition information was collected at the household level.[23] If households acquire similar types of food but children from nonobese-child households eat less or more healthfully, such differences will not be detected in this analysis. Fourth, existing studies show that households do not necessarily shop at the closest grocery stores (Ver Ploeg et al., 2015; Ver Ploeg and Rahkovsky, 2016). Therefore, even though obese-child households are more likely to live in areas with lower access to healthful foods, they may be purchasing healthful foods further away from home. Lastly, despite acquiring foods of similar nutritional quality, households

[22] The amount consumed would be smaller than the amount acquired if a household throws away part of the acquired food. The amount consumed would be greater than the amount acquired during the survey week if a household already had a large stock of food at home.

[23] The FAFH dataset includes information on which household member was present during each eating occasion but does not have information on who ate what food. The FAH dataset includes information on food acquired by a household but not on how the food was distributed among household members.

may engage in different amounts of physical activity, which can lead to different health outcomes for children. However, this hypothesis cannot be tested because FoodAPS did not collect information on physical activities.

In terms of attitudes toward healthful eating, FoodAPS respondents from both household types rated their households' diets and their own diets as about average, with scores of 3 out of 5 (table 8). Respondents from obese-child households rated their diets as slightly more healthful than did respondents from nonobese-child households. The size of the difference is small (0.3) but statistically significant. Given that there is no significant difference in the nutritional quality of acquired food (tables 6 and 7), one would not expect the respondents from obese-child households to rate the healthfulness of their diets higher than respondents from nonobese-child households.

Table 8
**Opinions on healthy eating by FoodAPS households, 2012**

| | Nonobese HH | Obese HH | Differences |
|---|---|---|---|
| Respondents' assessment of healthfulness of own diet | 3.1 | 2.9 | 0.2* |
| (1=excellent, 5=poor) | (0.0) | (0.1) | (0.1) |
| Respondents' assessment of healthfulness of HH diet | 3.3 | 3.0 | 0.3*** |
| (1=excellent, 5=poor) | (0.0) | (0.1) | (0.1) |
| Barriers to eating healthy (%) | | | |
| Price | 0.35 | 0.48 | -0.13*** |
| | (0.03) | (0.04) | (0.04) |
| Time constraint | 0.20 | 0.16 | 0.05 |
| | (0.02) | (0.03) | (0.04) |
| Respondents think healthy foods taste poor | 0.09 | 0.14 | -0.05** |
| | (0.01) | (0.03) | (0.02) |
| Households think healthy foods taste poor | 0.30 | 0.40 | -0.10* |
| | (0.04) | (0.05) | (0.05) |

Notes: ** p<0.1 ** p<0.05 *** p<0.001*. Averages using sample weights are reported in this table. Standard errors are clustered at the household level and are reported in parentheses. "Obese HH" = households with at least one obese child, and "non-obese HH" = households without any obese children.

Source: USDA, Economic Research Service using data from USDA's National Household Food Acquisition and Purchase Survey (FoodAPS), 2012.

FoodAPS also collected information on perceived barriers to more healthful eating (table 8). Public health advocates often speculate that time constraints force some people to eat fast food or processed food rather than more nutritious food prepared at home. However, the difference in the shares of the two household types choosing time constraints as a barrier to healthy eating is not statistically significant. Instead, the share of households that cite high prices of healthful food as a factor is 13 percentage points higher for obese-child households than for nonobese-child households. A higher share of obese-child households (10 percentage points) also says they do not like the taste of healthful food. Given that no significant relationship exists between diet quality and total daily food expenditure (Carlson et al., 2014), it is notable that obese-child households are more likely to point to high prices as the reason for not eating more healthfully.

# Conclusion

This study's main objective is to examine potential links between household characteristics and local food environments and childhood obesity. Findings show that children from households with at least one obese child live in disadvantageous environments relative to children from households without any obese children. Children from obese-child households are more likely than children from nonobese-child households to live with parents who are not married, have less education, and are financially constrained. They also tend to live in areas with lower access to healthful foods. The number of times children eat breakfast per week is an important correlate of childhood obesity, but whether a household eats at home or at a restaurant is not. FoodAPS respondents from obese-child households more frequently cite high food prices and poor flavor of healthful foods as barriers to eating more healthfully. Findings reveal no statistically significant differences in the nutritional quality of food acquired by the two household types.

The study's findings imply that household characteristics and food environments are important correlates of childhood obesity and thus may strengthen the intergenerational transfer of health and wealth. An adverse environment can result in obese parents with low socioeconomic status having obese children, who subsequently grow up to be obese adults themselves. These obese children are more likely to enter adulthood with poorer health and lower socioeconomic status than their nonobese peers (Cawley and Spiess, 2008), as obese individuals tend to fair worse in both job and marriage markets (Averett and Korenman, 1996; Cawley, 2004; Hamermesh and Biddle, 1994). A growing number of legislators have been trying to curb rising obesity rates locally by limiting the number of fast-food restaurants or by imposing taxes on sugar-sweetened beverages. The findings indicate that some of these proposed policies may be effective in lowering obesity rates, which would eventually weaken intergenerational transmission of health and wealth.

It is important to note that no causal inference can be drawn without more rigorous econometric analysis. Also, though the overall average obesity rate may not be biased in survey data, the distribution can be biased, particularly for children whose heights and weights are reported by their parents. Therefore, researchers should be cautious when drawing conclusions on childhood obesity rates using uncorrected parent-reported data.

# References


Aggarwal, A., P. Monsivais, and A. Drewnowski. "Nutrient Intakes Linked to Better Health Outcomes Are Associated With Higher Diet Costs in the US," *PLoS ONE* 7(2012):e37, 533.

Akinbami, L.J., and C.L. Ogden. 2009. "Childhood Overweight Prevalence in the United States: The Impact of Parent-Reported Height and Weight," *Obesity* 17(8):1574-1580.

Alviola, P.A., R.M. Nayga, M.R. Thomsen, D. Danforth, and J. Smartt. 2014. "The Effect of Fast Food Restaurants on Childhood Obesity: A School Level Analysis," *Economics & Human Biology* 12:110-119.

Anderson, P.M. 2012. "Parental Employment, Household Routines and Childhood Obesity," *Economics & Human Biology* 10(4):340-351.

Anderson, P.M., and K.F. Butcher. 2006. "Childhood Obesity: Trends and Potential Causes," *Future of Children* 16:19-45.

Anderson, P.M., K.F. Butcher, and D.W. Schanzenbach. 2009. "Childhood Disadvantage and Obesity: Is Nurture Trumping Nature?" in *An Economics Perspective on the Problems of Disadvantaged Youth*, J. Gruber (ed.), Cambridge, MA: National Bureau of Economic Research.

Anderson, P.M., K.F. Butcher, and P.B. Levine. 2003. "Maternal Employment and Overweight Children," *Journal of Health Economics* 22(3):477-504.

Averett, S., and S. Korenman. 1996. "The Economic Reality of the Beauty Myth," *Journal of Human Resources* 31(2):304-330.

Bhattacharya, J., J. Currie, and S.J. Haider. 2006. "Breakfast of Champions? The School Breakfast Program and the Nutrition of Children and Households," *Journal of Human Resources* 41(3):445-466.

Blaylock, J., D. Smallwood, K. Kassel, J. Variyam, and L. Aldrich. 1999. "Economics, Food Choices, and Nutrition," *Food Policy* 24(2):269-286.

Burkhauser, R.V., and J. Cawley. 2008. "Beyond BMI: The Value of More Accurate Measures of Fatness and Obesity in Social Science Research," *Journal of Health Economics* 27(2):519-529.

Capogrossi, K., and W. You. 2017. "The Influence of School Nutrition Programs on the Weight of Low-Income Children: A Treatment Effect Analysis," *Health Economics* 26(8):980-1000.

Carlson, A., D. Dong, and M. Lino. 2014. "Association Between Total Diet Cost and Diet Quality Is Limited," *Journal of Agricultural and Resource Economics* 39(1):47-68.

Carroll-Scott, A., K. Gilstad-Hayden, L. Rosenthal, S.M. Peters, C. McCaslin, R. Joyce, and J.R. Ickovics. 2013. "Disentangling Neighborhood Contextual Associations With Child Body Mass Index, Diet, and Physical Activity: The Role of Built, Socioeconomic, and Social Environments," *Social Science & Medicine* 95:106-114.

Case, A., and C. Paxson. 2002. "Parental Behavior and Child Health," *Health Affairs* 21(2):164-178.

Case, A., D. Lubotsky, and C. Paxson. 2002. "Economic Status and Health in Childhood: The Origins of the Gradient," *American Economic Review* 92(5):1308-1334.

Cawley, J. 2004. "The Impact of Obesity on Wages," *Journal of Human Resources* 39(2):451-474.

Cawley, J., and C.K. Spiess. 2008. "Obesity and Skill Attainment in Early Childhood," *Economics & Human Biology* 6(3):388-397.

Cawley, J., and F. Liu. 2012. "Maternal Employment and Childhood Obesity: A Search for Mechanisms in Time Use Data," *Economics & Human Biology* 10(4):352-364.

Centers for Disease Control and Prevention. 2017. (May 14). "General Food Environment Resources."

Chen, S.E., R.J. Florax, and S.D. Snyder. 2013. "Obesity and Fast Food in Urban Markets: A New Approach Using Geo-Referenced Micro Data," *Health Economics* 22(7):835-856.

Classen, T.J. 2010. "Measures of the Intergenerational Transmission of Body Mass Index Between Mothers and Their Children in the United States, 1981-2004," *Economics & Human Biology* 8(1):30-43.

Classen, T.J., and O. Thompson. 2016. "Genes and the Intergenerational Transmission of BMI and Obesity," *Economics & Human Biology* 23:121-133.

Clay, M., M. Ver Ploeg, A. Coleman-Jensen, H. Elitzak, C. Gregory, D. Levin, C. Newman, and M.P. Rabbitt. 2016. *Comparing National Household Food Acquisition and Purchase Survey (FoodAPS) Data With Other National Food Surveys' Data*, EIB-157, U.S. Department of Agriculture, Economic Research Service.

Clifton, K.J. 2004. "Mobility Strategies and Food Shopping for Low-Income Families: A Case Study," *Journal of Planning and Education Research* 23:402-413.

Condliffe, S., and C.R. Link. 2008. "The Relationship Between Economic Status and Child Health: Evidence From the United States," *American Economic Review* 98(4):1605-1618.

Courtemanche, C., and A. Carden. 2011. "Supersizing Supercenters? The Impact of Walmart Supercenters on Body Mass Index and Obesity," *Journal of Urban Economics* 69(2):165-181.

Currie, J., and M. Stabile. 2003. "Socioeconomic Status and Child Health: Why Is the Relationship Stronger for Older Children?" *American Economic Review* 93(5):1813-1823.

Currie, J., S. DellaVigna, E. Moretti, and V. Pathania. 2010. "The Effect of Fast Food Restaurants on Obesity and Weight Gain," *American Economic Journal: Economic Policy* 2(3):32-63.

Dahl, G.B., and L. Lochner. 2012. "The Impact of Household Income on Child Achievement: Evidence From the Earned Income Tax Credit," *American Economic Review* 102(5):1927-1956.

Datar A., N. Nicosia, and V. Shier. 2014. "Maternal Work and Children's Diet, Activity, and Obesity," *Social Science and Medicine* 107:196-204.

Drewnowski, A. "The Cost of U.S. Foods as Related to Their Nutritive Value," *American Journal of Clinical Nutrition* 92(2010):1181-1188.

Dunn, R.A. 2010. "The Effect of Fast Food Availability on Obesity: An Analysis by Gender, Race, and Residential Location," *American Journal of Agricultural Economics* 92(4):1149-1164.

Dunn, R.A., J.R. Sharkey, and S. Horel. 2012. "The Effect of Fast Food Availability on Fast Food Consumption and Obesity Among Rural Residents: An Analysis by Race/Ethnicity," *Economics and Human Biology* 10(1):1-13.

Fertig, A., G. Glomm, and R. Tchernis. 2009. "The Connection Between Maternal Employment and Childhood Obesity: Inspecting the Mechanisms," *Review of Economics of the Household* 7(3):227-255.

Fiese, B.H., A. Hammons, and D. Grigsby-Toussaint. 2012. "Household Mealtimes: A Contextual Approach to Understanding Childhood Obesity," *Economics and Human Biology* 10(4):365-374.

Gibson, D. 2003. "Food Stamp Program Participation Is Positively Related to Obesity in Low Income Women," *Journal of Nutrition* 133(7):2225-2231.

Gregory, C., I.M. Rahkovsky, and T. Anekwe. 2014. *Consumers' Use of Nutrition Information When Eating Out*, EIB-127, U.S. Department of Agriculture, Economic Research Service.

Guenther, P.M., K.O. Casavale, J. Reedy, S.I. Kirkpatrick, H.A. Hiza, K.J. Kuczynski et al. 2013. "Update of the Healthy Eating Index: HEI-2010," *Journal of the Academy of Nutrition and Dietetics* 113(4):569-580.

Guenther, P.M., S.I. Kirkpatrick, J. Reedy, S.M. Krebs-Smith, D.W. Buckman, K.W. Dodd, K.O. Casavale, and R.J. Carroll. 2014. "The Healthy Eating Index-2010 Is a Valid and Reliable Measure of Diet Quality According to the 2010 Dietary Guidelines for Americans," *Journal of Nutrition* 144:399-407.

Gundersen, C., B. Kreider, and J. Pepper. 2012. "The Impact of the National School Lunch Program on Child Health: A Nonparametric Bounds Analysis," *Journal of Econometrics* 166(1):79-91.

Guthrie, J.F., B.H. Lin, and E. Frazao. 2002. "Role of Food Prepared Away From Home in the American Diet, 1977-78 Versus 1994-96: Changes and Consequences," *Journal of Nutrition Education and Behavior* 34(3):140-150.

Hamermesh, D., and J. Biddle. 1994. "Beauty and the Labor Market," *American Economic Review* 84(5):1174-1194.

Harrison, F., A.P. Jones, E.M. van Sluijs, A. Cassidy, G. Bentham, and S.J. Griffin. 2011. "Environmental Correlates of Adiposity in 9-10 Year Old Children: Considering Home and School Neighborhoods and Routes to School," *Social Science and Medicine* 72(9):1411-1419.

Haslam, D.W., and W.P.T. James. 2005. "Obesity," *Lancet* 366(9492):1197-1209.

Jo, Y. 2016. "Does the Earned Income Tax Credit Increase Children's Weight? The Impact of Policy-Driven Income on Childhood Obesity," SSRN Working Paper.

Jo, Y. 2014. "What Money Can Buy: Household Income and Childhood Obesity," *Economics and Human Biology* 15:1-12.

Jo, Y., and Q. Wang. 2017. "The Impact of Maternal Employment on Children's Adiposity: Evidence From the China's Labor Policy Reform," *Health Economics.*

Kreider, B., J.V. Pepper, C. Gundersen, and D. Jolliffe. 2012. "Identifying the Effects of SNAP (Food Stamps) on Child Health Outcomes When Participation Is Endogenous and Misreported," *Journal of the American Statistical Association* 107(499):958-975.

Laska, M.N., M.O. Hearst, A. Forsyth, K.E. Pasch, and L. Lytle. 2010. "Neighborhood Food Environments: Are They Associated With Adolescent Dietary Intake, Food Purchases and Weight Status?" *Public Health Nutrition* 13(11):1757-1763.

Lee, H. 2012. "The Role of Local Food Availability in Explaining Obesity Risk Among Young School-Aged Children," *Social Science and Medicine* 74(8):1193-1203.

Lin, B.H. 2005. *Nutrition and Health Characteristics of Low-Income Populations: Body Weight Status*, AIB-796, U.S. Department of Agriculture, Economic Research Service.

Lopez, R.P. 2007. "Neighborhood Risk Factors for Obesity," *Obesity* 15(8):2111-2119.

Mancino, L., J.E. Todd, J. Guthrie, and B.H. Lin. 2014. "Food Away From Home and Childhood Obesity," *Current Obesity Reports* 3(4):459-469.

Mancino, L., J.E. Todd, J. Guthrie, and B.H. Lin. 2010. *How Food Away From Home Affects Children's Diet Quality,* ERR-104, U.S. Department of Agriculture, Economic Research Service.

Mokdad, A.H., E.S. Ford, B.A. Bowman, W.H. Dietz, F. Vinicor, V.S. Bales, and J.S. Marks. 2003. "Prevalence of Obesity, Diabetes, and Obesity-Related Health Risk Factors, 2001," *JAMA* 289(1):76-79.

Murasko, J.E. 2013. "Associations Between Household Income, Height, and BMI in Contemporary US Schoolchildren," *Economics and Human Biology* 11(2):185-196.

Murasko, J.E. 2009. "Socioeconomic Status, Height, and Child Obesity," *Economics and Human Biology* 7(3):376-386.

National Cancer Institute. 2017. (July 26). "The Overview and Background of the Healthy Eating Index."

Nielsen, S.J., and B.M. Popkin. 2003. "Patterns and Trends in Food Portion Sizes, 1977-1998," *Journal of the American Medical Association* 289(4):450-453.

Ogden, C.L., M.D. Carroll, B.K. Kit, and K.M. Flegal. 2014. "Prevalence of Childhood and Adult Obesity in the United States, 2011-2012," *Journal of the American Medical Association* 311(8):806-814.

Park, S., S. Onufrak, B. Sherry, and H.M. Blanck. 2014. "The Relationship Between Health-Related Knowledge and Sugar-Sweetened Beverage Intake Among US Adults," *Journal of the Academy of Nutrition and Dietetics* 114(7):1059-1066.

Phipps, S.A., L. Lethbridge, and P. Burton. 2006. "Long-Run Consequences of Parental Paid Work Hours for Child Overweight Status in Canada," *Social Science and Medicine* 62(4):977-986.

Powell, L.M., M.C. Auld, F.J. Chaloupka, P.M. O'Malley, and L.D. Johnston. 2007. "Associations Between Access to Food Stores and Adolescent Body Mass Index," *American Journal of Preventive Medicine* 33(4):S301-S307.

Power, C., J.K. Lake, and T.J. Cole. 1997. "Review: Measurement and Long-Term Health Risks of Child and Adolescent Fatness," *International Journal of Obesity and Related Metabolic Disorders* 21(7):507-526.

Ruhm, C.J. 2008. "Maternal Employment and Adolescent Development," *Labour Economics* 15(5):958-983.

Schanzenbach, D. 2009. "Do School Lunches Contribute to Childhood Obesity?" *Journal of Human Resources* 44(3):684-709.

Schmeiser, M.D. 2012. "The Impact of Long-Term Participation in the Supplemental Nutrition Assistance Program on Child Obesity," *Health Economics* 21(4):386-404.

Sturm, R., and A. Hattori. 2015. "Diet and Obesity in Los Angeles County 2007-2012: Is There a Measurable Effect of the 2008 'Fast-Food Ban'?" *Social Science and Medicine* 133:205-211.

Todd, J.E., and B. Scharadin. 2016. *Where Households Get Food in a Typical Week: Findings From USDA's FoodAPS*, EIB-156, U.S. Department of Agriculture, Economic Research Service.

Townsend, M.S., G.J. Aaron, P. Monsivais, N.L. Keim, and A. Drewnowski. "Less-Energy-Dense Diets of Low-Income Women in California Are Associated With Higher Energy-Adjusted Diet Costs," *American Journal of Clinical Nutrition* 89(2009):1220-1226.

U.S. Department of Agriculture, Center for Nutrition and Policy and Promotion (CNPP). 2016. (December 27). "Healthy Eating Index."

Variyam, J.N., J.R. Blaylock, B.H. Lin, K. Ralston, and D.M. Smallwood, 1999. "Mother's Nutrition Knowledge and Children's Dietary Intakes," *American Journal of Agricultural Economics* 81(2):373-384.

Variyam, J.N., J.R. Blaylock, D.M. Smallwood, and P.P. Basiotis. 1998. *USDA's Healthy Eating Index and Nutrition Information*, TB-1866, U.S. Department of Agriculture, Economic Research Service.

Ver Ploeg, M.L., and I. Rahkovsky. 2016. (May). "Recent Evidence on the Effects of Food Store Access on Food Choice and Diet Quality," *Amber Waves*," U.S. Department of Agriculture, Economic Research Service.

Ver Ploeg, M.L., and K.L. Ralston. 2008. *Food Stamps and Obesity: What Do We Know?* EIB-34, U.S. Department of Agriculture, Economic Research Service.

Ver Ploeg, M.L., L. Mancino, J.E. Todd, D.M. Clay, and B. Scharadin. 2015. *Where Do Americans Usually Shop for Food and How Do They Travel To Get There? Initial Findings From the*

*National Household Food Acquisition and Purchase Survey*, EIB-138, U.S. Department of Agriculture, Economic Research Service.

Wada, R., and E. Tekin. 2010. "Body Composition and Wages," *Economics & Human Biology 8*(2):242-254.

Wang, M.C., S. Kim, A.A. Gonzalez, K.E. MacLeod, and M.A. Winkleby. 2007. "Socioeconomic and Food-Related Physical Characteristics Are Associated With Body Mass Index," *Journal of Epidemiology and Community Health* 61:491-498.

Wardle, J., K. Parmenter, and J. Waller. 2000. "Nutrition Knowledge and Food Intake," *Appetite* 34(3):269-275.

Weden, M.M., P.B. Brownell, M.S. Rendall, C. Lau, M. Fernandes, and Z. Nazarov. 2013. "Parent-Reported Height and Weight as Sources of Bias in Survey Estimates of Childhood Obesity," *American Journal of Epidemiology* 178(3):461-473.

Zick, C.D., K.R. Smith, J.X. Fan, B.B. Brown, I. Yamada, and L. Kowaleski-Jones. 2009. "Running to the Store? The Relationship Between Neighborhood Environments and the Risk of Obesity," *Social Science and Medicine* 69(10):1493-1500.

# Appendix

Appendix table 1
**Shares of overweight or obese by race, sex, and age groups in FoodAPS versus NHANES**

| | FoodAPS | | | |
|---|---|---|---|---|
| | 2-19 years | 2-5 years | 6-11 years | 12-19 years |
| Panel A. Percent overweight or obese (BMI≥85th percentile) | | | | |
| All | 35.6 | 36.9 | 38.8 | 32.8 |
| Boys | 37.8 | 38.1 | 39.7 | 36.5 |
| Girls | 33.4 | 35.8 | 38.0 | 29.1 |
| Non-Hispanic White | 32.8 | 34.2 | 34.3 | 31.2 |
| Boys | 35.6 | 37.3 | 35.4 | 35.1 |
| Girls | 30.3 | 31.7 | 33.4 | 27.5 |
| Non-Hispanic Black | 40.2 | 55.5 | 43.6 | 33.8 |
| Boys | 39.9 | 55.3 | 43.9 | 33.2 |
| Girls | 40.5 | 55.6 | 43.1 | 34.5 |
| Hispanic | 40.2 | 34.6 | 48.0 | 36.7 |
| Boys | 42.4 | 31.9 | 48.5 | 43.5 |
| Girls | 38.1 | 37.4 | 47.6 | 30.0 |
| Panel B. Percent obese (BMI≥95th percentile) | | | | |
| All | 19.1 | 26.4 | 22.3 | 13.9 |
| Boys | 21.1 | 24.9 | 24.7 | 17.2 |
| Girls | 17.1 | 27.8 | 20.0 | 10.7 |
| Non-Hispanic White | 16.9 | 22.6 | 18.5 | 13.7 |
| Boys | 19.5 | 23.4 | 20.5 | 17.5 |
| Girls | 14.6 | 22.0 | 16.6 | 10.0 |
| Non-Hispanic Black | 22.8 | 46.3 | 30.4 | 11.5 |
| Boys | 20.6 | 40.1 | 30.2 | 9.2 |
| Girls | 25.4 | 52.2 | 30.8 | 14.2 |
| Hispanic | 22.6 | 26.3 | 27.7 | 16.7 |
| Boys | 25.8 | 21.2 | 32.4 | 23.4 |
| Girls | 19.6 | 31.8 | 23.9 | 10.1 |

—continued

Appendix table 1

**Shares of overweight or obese by race, sex, and age groups in FoodAPS versus NHANES—continued**

| | NHANES | | | |
|---|---|---|---|---|
| | 2-19 years | 2-5 years | 6-11 years | 12-19 years |
| Panel A. Percent overweight or obese (BMI≥85th percentile) | | | | |
| All | 31.8 (29.1-34.7) | 22.8 (18.7-27.6) | 34.2 (30.1-38.5) | 34.5 (30.1-39.2) |
| Boys | 32.0 (29.2-35.0) | 23.9 (20.1-28.2) | 33.2 (27.7-39.1) | 35.1 (29.7-40.9) |
| Girls | 31.6 (27.2-36.5) | 21.7 (14.6-31.0) | 35.2 (29.2-41.8) | 33.8 (27.9-40.4) |
| Non-Hispanic White | 28.5 (24.0-33.4) | 20.9 (14.4-29.2) | 29.4 (21.6-38.7) | 31.2 (24.3-39.1) |
| Boys | 27.8 (22.5-33.8) | 21.8 (14.9-30.8) | 26.5 (18.2-36.8) | 31.5 (21.9-42.9) |
| Girls | 29.2 (22.7-36.7) | 19.9 (10.0-35.7) | 32.7 (19.8-48.8) | 31.0 (22.7-40.7) |
| Non-Hispanic Black | 35.2 (30.2-40.6) | 21.9 (16.7-28.2) | 38.1 (30.1-46.8) | 39.8 (32.9-47.2) |
| Boys | 34.4 (30.3-38.7) | 22.2 (16.9-28.6) | 39.3 (30.5-48.9) | 37.3 (30.3-44.9) |
| Girls | 36.1 (28.7-44.4) | 21.6 (14.6-30.8) | 36.9 (26.9-48.1) | 42.5 (31.9-53.8) |
| Hispanic | 38.9 (36.3-41.6) | 29.8 (24.0-36.4) | 46.2 (41.5-50.9) | 38.1 (31.9-44.8) |
| Boys | 40.7 (37.3-44.1) | 31.4 (23.5-40.5) | 48.7 (41.1-56.3) | 39.6 (31.3-48.5) |
| Girls | 37.0 (33.4-40.8) | 28.1 (19.7-38.3) | 43.6 (37.5-49.8) | 36.5 (28.8-45.0) |
| Panel B. Percent obese (BMI≥95th percentile) | | | | |
| All | 16.9 (14.9-19.2) | 8.4 (5.9-11.6) | 17.7 (14.5-21.4) | 20.5 (17.1-24.4) |
| Boys | 16.7 (13.9-19.8) | 9.5 (6.2-14.3) | 16.4 (12.9-20.6) | 20.3 (15.7-25.9) |
| Girls | 17.2 (14.8-19.9) | 7.2 (3.8-13.1) | 19.1 (15.8-22.8) | 20.7 (16.8-25.1) |
| Non-Hispanic White | 14.1 (10.8-18.2) | 3.5 (1.4-8.0)[1,2] | 13.1 (7.5-22.0) | 19.6 (14.1-26.5) |
| Boys | 12.6 (8.3-18.9) | 6.3 (2.2-17.0)[1,2] | 8.8 (3.9-18.6)[2] | 18.3 (10.7-29.5) |
| Girls | 15.6 (11.6-20.7) | 0.6 (0.1-5.0)[1,2] | 17.9 (10.8-28.1) | 20.9 (13.9-30.1) |
| Non-Hispanic Black | 20.2 (16.7-24.2) | 11.3 (7.3-17.1) | 23.8 (17.8-31.1) | 22.1 (15.8-29.9) |
| Boys | 19.9 (17.6-22.4) | 9.0 (3.7-20.3)[2] | 25.9 (19.8-33.2) | 21.4 (16.2-27.8) |
| Girls | 20.5 (14.6-28.0) | 13.9 (9.0-20.7) | 21.7 (13.9-32.2) | 22.7 (14.0-34.8) |
| Hispanic | 22.4 (20.3-24.6) | 16.7 (12.0-22.7) | 26.1 (22.5-29.9) | 22.6 (17.7-28.5) |
| Boys | 24.1 (21.1-27.3) | 18.0 (11.7-26.8) | 28.6 (22.3-35.9) | 23.9 (18.2-30.6) |
| Girls | 20.6 (17.6-24.0) | 15.2 (7.9-27.1) | 23.4 (18.2-29.5) | 21.3 (15.0-29.2) |

Notes: Table reports weighted means. FoodAPS contains a small number of non-Hispanic Asians; hence, the means are not reported for this group. For National Health and Nutrition Examination Survey (NHANES) data, the 95-percent confidence intervals are presented in parentheses. BMI = body mass index.

[1] Number of observations is less than 10.

[2] Relative standard error is greater than 30 percent but less than 40 percent.

Source: USDA, Economic Research Service using data from USDA's National Household Food Acquisition and Purchase Survey (FoodAPS), 2012, and table 3 in Ogden et al. (2014).

Appendix table 2

**Share of overweight or obese by race, sex, and age groups in FoodAPS after the correction**

| | NHANES corrected[1] | | | | NLSY-CH corrected[2] | | | |
|---|---|---|---|---|---|---|---|---|
| | 2-19 years | 2-5 years | 6-11 years | 12-19 years | 2-19 years | 2-5 years | 6-11 years | 12-19 years |
| Panel A. Percent overweight or obese (BMI≥85th percentile) | | | | | | | | |
| All | 33.0 | 24.6 | 38.8 | 32.8 | 38.4 | 33.8 | 38.8 | 40.0 |
| Boys | 35.4 | 26.0 | 39.7 | 36.5 | 37.9 | 38.7 | 39.7 | 36.5 |
| Girls | 30.8 | 23.5 | 38.0 | 29.1 | 38.9 | 29.5 | 38 | 43.5 |
| Non-Hispanic White | 30.8 | 24.0 | 34.3 | 31.2 | 34.8 | 29.0 | 34.3 | 37.4 |
| Boys | 34.3 | 30.1 | 35.4 | 35.1 | 35.9 | 39.2 | 35.4 | 35.1 |
| Girls | 27.6 | 19.3 | 33.4 | 27.5 | 33.9 | 21.1 | 33.4 | 39.6 |
| Non-Hispanic Black | 35.8 | 27.8 | 43.6 | 33.8 | 41.8 | 30.7 | 43.6 | 43.9 |
| Boys | 34.8 | 20.0 | 43.9 | 33.2 | 36.0 | 26.9 | 43.9 | 33.2 |
| Girls | 37.1 | 35.4 | 43.1 | 34.5 | 48.8 | 34.5 | 43.1 | 56.3 |
| Hispanic | 37.3 | 24.7 | 48.0 | 36.7 | 46.3 | 46.5 | 48.0 | 44.8 |
| Boys | 38.9 | 20.9 | 48.5 | 43.5 | 44.9 | 42.9 | 48.5 | 43.5 |
| Girls | 35.8 | 28.5 | 47.6 | 30.0 | 47.6 | 50.4 | 47.6 | 46.2 |
| Panel B. Percent obese (BMI≥95th percentile) | | | | | | | | |
| All | 15.8 | 9.8 | 22.3 | 13.9 | 19.7 | 24.1 | 22.3 | 16.1 |
| Boys | 18.4 | 10.8 | 24.7 | 17.2 | 21.4 | 26.8 | 24.7 | 17.2 |
| Girls | 13.3 | 9.0 | 20.0 | 10.7 | 18.0 | 21.7 | 20.0 | 15.0 |
| Non-Hispanic White | 14.3 | 9.1 | 18.5 | 13.7 | 18.0 | 23.8 | 18.5 | 15.3 |
| Boys | 17.6 | 12.7 | 20.5 | 17.5 | 20.9 | 31.1 | 20.5 | 17.5 |
| Girls | 11.4 | 6.4 | 16.6 | 10.0 | 15.3 | 18.1 | 16.6 | 13.3 |
| Non-Hispanic Black | 16.9 | 8.6 | 30.4 | 11.5 | 18.9 | 15.7 | 30.4 | 13.0 |
| Boys | 15.7 | 5.6 | 30.2 | 9.2 | 17.1 | 14.7 | 30.2 | 9.2 |
| Girls | 18.4 | 11.6 | 30.8 | 14.2 | 21.2 | 16.6 | 30.8 | 17.5 |
| Hispanic | 19.0 | 11.8 | 27.7 | 16.7 | 25.0 | 28.6 | 27.7 | 21.1 |
| Boys | 22.4 | 9.6 | 32.4 | 23.4 | 26.2 | 23.4 | 32.4 | 23.4 |
| Girls | 15.9 | 14.0 | 23.9 | 10.1 | 23.9 | 34.3 | 23.9 | 18.8 |

Notes: Table reports weighted means from FoodAPS after the adjustments. BMI = body mass index.

[1] Heights of children age 2-5 are adjusted using the National Health and Nutrition Examination Survey (NHANES) 2011-2012.

[2] Heights of children age 2-5 and weights of female adolescents age 12-14 are adjusted using the Child Supplement of the National Longitudinal Survey of Youth 79 (NLSY-CH).

Source: USDA, Economic Research Service using data from USDA's National Household Food Acquisition and Purchase Survey (FoodAPS), 2012.

Appendix table 3
**Description of variables**

| Variable | FoodAPS source file | Description |
|---|---|---|
| **Demographic characteristics** | | |
| Age, race, gender, employment, marital status, BMI | individual | |
| Rural | household | If the population-weighted centroid of a census tract is in an area with less than 2,500 people, then it is defined as rural according to the Census Bureau's urbanized area definitions and is coded 1, otherwise 0. |
| **Financial well-being** | | |
| Monthly income | household | Total monthly household income as the sum of average household members' income from the six income categories (earnings; unemployment insurance; retirement and disability; welfare, child support, and alimony; investments; and other income sources.) |
| Nonfood expenditures per person | household | Total monthly nonfood expenditures as the sum of reported expenditures on 14 categories (rent or mortgage; rental or homeowners' insurance; property taxes; public transport; electricity; heating fuel; sewer and garbage/trash removal; health insurance; health insurance copays; doctor and hospital bills; prescription drugs; child care; child support; adult care) divided by the number of HH members. |
| Own a house | household | The question asked whether a HH owns, rents, or does not pay for the residential unit. A HH that owns is coded as 1, otherwise 0. |
| Own a car | household | The question asked if any HH member owns, leases, or both. If any HH member owns, leases, or both then 1, otherwise 0. |
| Number of cars owned | household | Total number of vehicles owned or leased. |
| Participate in SNAP | household | Constructed from two questions: (1) is anyone in HH receiving the benefits? and (2) did anyone in HH ever receive the benefits? If primary respondent answered "yes" to either one of the questions then 1, otherwise 0. |
| **Household food environment** | | |
| Number of food stores (super stores, supermarkets, convenience stores) | access | The file was created using the HH geocode file and the USDA Store Tracking and Redemption Subsystem. |
| Number of restaurants (fast food, sit-down) | access | The file was created using the HH geocode file and InfoUSA. |
| Distance to food stores or restaurants | access | The distance measures a "straight-line" distance between HH residence and the store location. |

—continued

Appendix table 3
**Description of variables—continued**

| Variable | FoodAPS source file | Description |
|---|---|---|
| **Food consumption patterns** | | |
| Number of times HH ate out | household | Number of times HH went out for dinner during the survey week (min=0, max=7). |
| Number of times HH prepared dinner at home | household | Number of times HH prepared dinner at home during the survey week (min=0, max=7). |
| Number of times HH ate dinner together | household | Number of times HH ate dinner together, at home or away, during the survey week (min=0, max=7). |
| Number of times a child ate a meal (breakfast, lunch, dinner, snack) | meals | Sum of the counts that a person ate a particular meal during the survey week. Missing data were not counted. |
| **Nutrients** | | |
| Additional calories acquired per household | FAH/FAFH nutrient(n), events(e) | Using the total gram weight of an item(n), the calories per 100 grams(n), the number of HH members at an event(e), the day of the week(e), the average daily calories acquired per household is calculated. Then, the recommended daily caloric intake for each HH (based on the *2010 Dietary Guidelines for Americans*) is subtracted from it to calculate the additional calories acquired by each household. |
| Protein, dietary fiber, sugar, fat, added sugar | FAH/FAFH nutrient(n), events(e) | Using the total gram weight of an item(n), the nutrients per 100 grams(n), the number of HH members at an event(e), the day of the week(e), the average daily nutrients acquired per household is calculated. Then, this is divided by standard adult equivalent (SAE) to obtain the average daily nutrient acquired per HH member accounting for HH compositions. |
| Healthy Eating Index | FAH/FAFH nutrient(n), events(e) | See box "Healthy Eating Index" on page 5 for details. |
| **Attitudes toward healthy eating** | | |
| Respondent's assessment of healthiness of his/her and HH diet | household | 1=excellent, 2=very good, 3=good, 4=fair, 5=poor |
| Reasons for not eating healthy | household | The respondent answered either yes or no. |

HH = household. BMI = body mass index. FAH = food at home. FAFH = food away from home.

Source: USDA, Economic Research Service.