

Featured Article

The National Household Food Acquisition and Purchase Survey: Innovations and Research Insights

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Abstract *Evidence-based policies that effectively address adverse public health trends, including the increasing burden of diet-related disease and food insecurity, require quality and comprehensive data. For food and nutrition policy, that means data on household and individual food choices and the many factors influencing food demand, including income, food assistance program participation, food security status, and the local food environment. To meet this data need, the USDA sponsored the National Household Food Acquisition and Purchase Survey (FoodAPS), an innovative survey that collected nationally-representative data on household food purchases and acquisitions, including from low-income households and households participating in the Supplemental Nutrition Assistance Program (SNAP). To further enable and enrich analysis, the household survey data were linked to SNAP administrative records, USDA nutrient data, and geographic information related to the local food environment. This article provides a thorough overview of FoodAPS, including the rationale for the survey, recent research findings and insights on American diet quality, food assistance programs, and food environment, as well as the challenges encountered from developing, collecting, and processing the data.*

Key words: Food, Expenditures, Food Assistance, Food Environment, Household Survey, Diary Survey.

JEL codes: C83, I38, Q18.

Incidences of diet-related diseases, including obesity, cardiovascular disease, high blood pressure, diabetes, and some cancers have significantly increased in recent years ([The U.S. Burden of Disease Collaborators 2018](#)). At the same time, food insecurity—insufficient access to nutritious foods—remains a serious problem for an estimated 11.8% of U.S. households ([Gundersen, Kreider, and Pepper 2011](#); [Coleman-Jensen et al. 2018](#); [Gundersen and Ziliak 2018](#)). To develop successful evidence-based policies and strategies that effectively address these adverse public health trends, policymakers must fully understand all factors related to household and individual food choices, including socioeconomic status, time constraints, and local food environments. This requires comprehensive and nationally-representative data on American food purchases and acquisitions, recently made available by the National Household Food Acquisition and Purchase Survey (FoodAPS) sponsored by the USDA. These data are essential for understanding the complex dynamics of food demand.

The objective of this article is to provide a complete overview of FoodAPS, including the motivation for the survey, recent research contributions, challenges of fielding the survey, and future directions. These data are unique in that they include detailed information on *all* foods purchased or otherwise acquired for consumption at home and away from home, including foods acquired through nutrition assistance programs and foods acquired for free. Additionally, these data allow for robust comparisons between demographic and socioeconomic groups, including households above and below the federal poverty guideline and households participating in food assistance programs and households that do not. From the early stages of development, the central aim has always been to support crucial research on national priorities, including health and obesity, food security, and nutrition assistance policy. The data have already enabled policy-relevant research on diet quality, food assistance programs, and food access.

Developing, collecting, and processing the data inevitably presented many challenges. These challenges included minimizing response burden and response fatigue, confirming food assistance program participation through administrative data matching, accurately measuring household and individual income, precisely identifying all food acquisitions, and adopting new survey technologies. The lessons learned from addressing and overcoming these challenges will certainly inform and improve future data collection efforts.

Background and Motivation

Prior to FoodAPS, research on food choice, food policy impacts, and food assistance programs was restricted due to inherent limitations in the available data. In a 2005 comprehensive report, the National Research Council (NRC) highlighted the lack of existing data necessary to analyze behaviors and choices related to food consumption among U.S. households ([NRC 2005](#)). While other food consumption and expenditure datasets contain critical data, they often fail to provide a complete and detailed picture of total U.S. household food acquisitions and food assistance program participation. The Survey of Income and Program Participation (SIPP), conducted by the U.S. Census Bureau, collects detailed food assistance program participation information, but does not collect information on food purchases or expenditures. The National Health and Nutrition Examination Survey (NHANES),

conducted by the National Center for Health Statistics, includes dietary intake data for two non-consecutive days and is linked to individual biometric health data. These data, however, do not include information on food purchases, such as quantities and prices paid, and do not represent an entire household unit. Proprietary consumer panels, such as the Nielsen Homescan and the IRI Consumer Network, include detailed information on household food purchases from grocery establishments and other retail stores, but do not include foods purchased or obtained from other sources, such as restaurants and food pantries, and underrepresent low-income households and households with children (Muth et al. 2016).

Perhaps the most well-known survey that collects information on all expenditures, including food, is the Consumer Expenditure Survey (CE) of the Bureau of Labor Statistics (BLS). While the CE collects household food expenditures, the data are aggregated into broad food categories. This aggregation prevents close examination of the nutritional content of individual purchases and an overall analysis of diet quality. Additionally, food assistance program participation is underreported in the CE (Meyer, Mok, and Sullivan 2009), and while the CE includes items paid for with food assistance benefits, it is not possible to link individual food items to their source of payment (Hoynes, McGranahan, and Schanzenbach 2015). Finally, foods acquired for free are excluded from the CE, which omits an important source of food for many families and prevents an analysis of comprehensive diet quality and behaviors related to food choice.

The Economic Research Service (ERS) and Food and Nutrition Service (FNS) of the USDA recognized the need for comprehensive data on household food acquisitions, especially among low-income households. To fill this data gap and enable research on a variety of topics, including diet quality, food security, and food access, ERS and FNS cosponsored a contract with Mathematica Policy Research (Mathematica) to conduct the National Household Food Acquisition and Purchase Survey (FoodAPS). Data collected through FoodAPS have enabled the exploration of previously unanswered research questions related to the food purchase and acquisition patterns of U.S. households, particularly for food-insecure households and households participating in Supplemental Nutrition Assistance Program (SNAP), the nutritional quality of purchased foods, and the relationship between food access and food acquisitions.

FoodAPS Data: An Overview

FoodAPS collected detailed information on all household food acquisitions. This includes foods from food-at-home (FAH) retailers (e.g., supermarkets, grocery stores, and farmers markets), food-away-from-home (FAFH) establishments (e.g., restaurants, fast-food vendors, and schools), and foods obtained for free (e.g., from food pantries, community centers, and from family and friends).¹ Low-income households and households participating in SNAP were oversampled to allow for research on food

¹There are no standard definitions for food at home (FAH) and food away from home (FAFH), and the FoodAPS survey instruments never used these terms. Respondents were simply asked to record “foods and drinks brought into the home” in one food diary (i.e., the blue pages) and “meals, snacks, and drinks outside of the home” in a separate food diary (i.e., the red pages). Both event-level and item-level information from these diaries remain separated in the data files available to researchers and are referred to as either FAH or FAFH.

behaviors for populations that are often underrepresented in other surveys. Specifically, FoodAPS was designed to provide nationally representative estimates of food demand within four target groups: SNAP households; non-SNAP households below the poverty guideline; non-SNAP households with income 100% to 185% of the poverty guideline; and non-SNAP households with income equal to or greater than 185% of the poverty guideline. Details on the number of observations collected for each of these target groups are provided in [table 1](#).

FoodAPS was fielded from April 2012 to January 2013 with 4,826 participating households. Surveyed households were asked to report all foods purchased or acquired for free over a seven-day survey period by scanning barcodes on FAH items, saving their store and restaurant receipts, and recording information in food booklets. For each acquisition event, households reported where the event took place and, if purchased, the total cost for all items and source(s) of payment (e.g., cash, credit or debit card, and SNAP benefits). Additionally, households were asked to report a description of every food item acquired, including quantity, size, and cost. Each household member also reported which meals and snacks were eaten each day of the survey week.

The household member responsible for meal planning and grocery shopping was identified as the primary respondent (PR) and was asked to complete two in-person interviews: one before the start of the survey week and one at the end. During these interviews, questions were asked about household characteristics such as income, composition of the household, food security, health status, diet and nutrition knowledge, and food assistance program participation. Several questions were also asked about household expenses (e.g., rent, health insurance premiums, electricity, and child care) to determine a household's income eligibility for SNAP and, if eligible, potential benefit amounts.

Several other innovations improved the overall usability and quality of the FoodAPS data. First, FoodAPS includes a geography component that provides a comprehensive picture of food access and the local food environment. Using a combination of public and proprietary data sources, measures of the local food retail environment were developed and appended to the FoodAPS data using the location of surveyed households.² The data include the location and density of different types of retailers, measures of access to these retailers, measures of food prices by retailer, as well as information on area demographics and food-related policies.

Second, to obtain a more accurate picture of SNAP participation, consenting FoodAPS households were matched to SNAP administrative records to confirm self-reported program participation status. Through a combination of data matching and direct household reporting, 1,581 FoodAPS households were determined to include active SNAP participants. Without the match to administrative data, 134 of these households would have been incorrectly classified as non-SNAP households and an additional 16

²The geography component data sources include the 2010 U.S. Census, the American Community Survey, Nielsen TDLinx, the FNS Store Tracking and Redemption System (STARS), the USDA Farmers Market Directory, InfoUSA Restaurant Database, Emergency Food System Data from Feeding America, the ERS Food Access Research Atlas, County Business Patterns from the U.S. Census Bureau, the Common Core of Data from the Department of Education, the Classification of Laws Associated with School Students (CLASS), State Sales Tax on Soda and Snack Foods, and the ERS SNAP Policy Database.

Table 1 FoodAPS by the Numbers

	Full survey	SNAP households	Non-SNAP households with income < 100% of the poverty guideline	Non-SNAP households with income ≥ 100% and < 185% of the poverty guideline	Non-SNAP households with income ≥ 185% of the poverty guideline
Households	4,826	1,581	346	851	2,048
Individuals	14,317	5,414	964	2,375	5,564
Children (age 0–11)	2,739	1,367	162	424	786
Youth (age 11–13)	702	316	54	118	214
Teens (age 14–18)	1,163	468	98	208	389
Adults (age 19–64)	8,399	2,974	549	1,321	3,555
Seniors (age 65+)	1,314	289	101	304	620
FAH events	15,998	5,545	1,134	2,711	6,608
FAFH events	39,120	12,371	2,311	6,329	18,109
FAH items	143,050	51,145	8,693	21,878	61,334
FAFH items	116,074	37,140	6,831	18,480	53,623

Note: These numbers represent unweighted frequencies.

households would have been incorrectly treated as SNAP households.³ Perhaps because consenting households were made aware that their responses would be matched to administrative records, the level of SNAP participation misreporting was relatively low compared to other national surveys (see Bollinger and David 1997, 2001; Meyer, Mok, and Sullivan 2009; Meyer and Goerge 2011; Mabli and Malsberger 2013).

Finally, nutrient information for reported foods was appended to the data using scanned barcodes and product descriptions.⁴ These data include information on the micro- and macro-nutrient content as well as Food Pattern Equivalent (FPE) values for each identifiable food item reported.⁵ The inclusion of nutrient data in FoodAPS supports diet quality analyses and estimation of diet quality indices such as the Healthy Eating Index (HEI).

All FoodAPS data and related components are available for researchers on a restricted-use and public-use basis. The restricted-use data files contain confidential information and pose a risk with regard to disclosing the identity of survey respondents. These data are protected under the Confidential Information Protection and Statistical Efficiency Act (CIPSEA) of 2002, which requires that the data be used strictly for research and statistical purposes. Only approved researchers can have access to the restricted-use files, which are stored on a secure data enclave at the National Opinion Research Center (NORC), an independent research organization at the University of Chicago. In contrast, the public-use data files have been stripped of data that pose any risk of disclosing confidential information and are freely available to the public. While these data contain less information than the restricted-use files, they still include over 1,000 variables that capture information about items purchased and acquired, payment methods, and demographic and socioeconomic information.

Data Evaluation and Validation

Several independent assessments of the FoodAPS data were conducted to evaluate data quality and accuracy. The primary evaluation was conducted by Westat, Inc. under contract with the ERS, with the central objective of evaluating the data collection and processing procedures. The results of this independent, third-party assessment are contained in five evaluation reports available on the FoodAPS webpage.⁶ The report topics include the following: instrument design, respondent burden, use of incentives, and response rate (Yan and Maitland 2016); sample design (Krenzke and Kali 2016); data accuracy and completeness (Maitland and Li 2016); nonresponse bias

³Note, however, that only 20 of the 27 states where FoodAPS data were collected provided SNAP participant files. Therefore, the number of misclassified households would likely have been larger had administrative files been provided by all state agencies.

⁴The nutrient information was sourced from several databases developed by the Agricultural Resource Service (ARS) of the USDA: the National Nutrient Database for Standard Reference (SR), the Food and Nutrient Database for Dietary Studies (FNDDS), the Food Patterns Equivalents Database (FPED), the Food Patterns Ingredients Database (FPID), the Fourth School Nutrition Dietary Assessment Study (SNDA-IV), and the What We Eat in America (WWEIA) Food Categories.

⁵FPE values represent the 37 components necessary for evaluating food and beverage intakes with respect to federal dietary guidelines. For example, these include the cup equivalents of fruits and vegetables and the teaspoon equivalents of added sugars.

⁶The ERS website for FoodAPS data is ers.usda.gov/foodaps. Here, users will find public-use data files and codebooks, survey instruments and documentation, data evaluation reports, key charts and statistics, current research projects and publications, and answers to frequently asked questions.

(Petraglia, Van de Kerckhove, and Krenzke 2016), and imputation methods (Li, Van de Kerckhove, and Krenzke 2016). Findings from the reports identified areas of the survey that could be modified to provide higher quality data in future FoodAPS data collection efforts. These efforts are discussed in greater detail in the final section.

Additionally, Clay et al. (2016) completed an extensive study, which compared key outcome measures from FoodAPS with those from other major national federal surveys, including NHANES, SIPP, CE, the National Health Interview Survey (NHIS), the Current Population Survey Food Security Supplement (CPS-FSS), and a proprietary consumer panel, the IRI Consumer Network. The primary findings were as follows:

- FoodAPS respondents reported more spending on food than respondents of the CE survey and the IRI Consumer Network (which both use a diary-style data collection approach), but less food spending than respondents of the NHANES (which uses a monthly spending recall approach).
- SNAP participation estimates from FoodAPS are on par with estimates from SIPP, which collects information on income, employment, and program participation and eligibility.⁷
- FoodAPS households were more likely to report experiencing low or very low food security in the past 30 days compared to the NHIS and CPS-FSS. Indeed, 8% of CPS-FSS households and 11% of NHIS households reported experiencing low to very low food security compared to nearly 16% of FoodAPS households.⁸
- FoodAPS respondents were more likely to be overweight (31%) compared to NHANES respondents (25%). However, this may be due to self-reporting error. While medical professionals take height and weight measurements of NHANES survey participants, heights and weights were reported by the primary respondent in FoodAPS.

Overall, the authors concluded that estimates of food spending, food security, SNAP participation, and diet and health behaviors from FoodAPS were within plausible bounds of estimates from other surveys.

Policy Research with FoodAPS Data

The availability of the FoodAPS data has paved the way for many new contributions to the food demand and food policy literature. These recent studies can be categorized into one or more of three main research areas: the diet quality of U.S. households, the impact of food assistance programs on household food choices, and the significance of the local food environment in shaping household food behavior.

⁷SIPP SNAP participation estimates include both the broad-based definition (e.g., all residents of a residential unit with at least one member participating in SNAP) and the SNAP-unit definition (e.g., only the residents of the unit that are covered by SNAP, which may be a subunit of a broad SIPP household). SNAP participation in FoodAPS is defined as at least one member of the household participating in SNAP. Both SIPP estimates of SNAP participation do not differ statistically from that of FoodAPS.

⁸One hypothesis for the higher rate of food insecurity in FoodAPS is that respondents had a heightened awareness of food security issues after having reported all food acquisitions for a week. The food security questions were placed in the final interview and not in the initial interview because the USDA did not want the questions to affect food acquisition behavior during the food reporting week.

Diet Quality

Food purchases and acquisitions are key determinants of nutritional diet quality, and diet quality is, in turn, a key determinant of health. Poor diets are known to contribute to many adverse health outcomes, including cardiovascular disease, certain cancers, and obesity. To assess the nutritional quality of purchases and acquisitions made by FoodAPS households during the food reporting week, Mancino et al. (2018) estimate the HEI-2010, a standard measure of diet quality. The HEI-2010 measures nutritional quality in terms of conformance to the federal dietary recommendations found in the *Dietary Guidelines for Americans*, and is comprised of nine food groups that are recommended for consumption (e.g., fruits and vegetables) and three food groups that should be avoided (e.g., empty calories). Analyzing FoodAPS data, the authors find that the average HEI score for U.S. households is 53 out of 100 points, suggesting that the food acquisitions of American households are far from compliant with federal dietary guidance, which is consistent with previous findings (Dietary Guidelines Advisory Committee 2015).

As previously emphasized, unlike other nationally representative food surveys, FoodAPS oversampled SNAP households and other low-income households to enable robust comparisons of food acquisition patterns, which are important for program evaluation and policy analysis. Mancino et al. (2018) exploited this distinction to examine differences in diet quality by household economic status, food assistance program participation, access to food retailers, and purchase source (e.g., grocery stores versus restaurants and FAH versus FAFH). These authors' results reveal that, on average, SNAP households have lower HEI scores than both lower- and higher-income nonparticipant households. However, the authors are careful to note that these results do not indicate that SNAP participation leads to poor diet quality, but rather that SNAP households differ from other groups along many factors including age, household composition, and education, which also have significant impacts on food purchase choices. This point of caution is similarly emphasized by Rigdon et al. (2017). Using FoodAPS data, these authors find that any positive association between SNAP and body mass index (BMI) is likely confounded by unmeasured covariates, echoing the findings of previous work examining the relationship between SNAP and obesity (see Gundersen (2015) for a review of the relevant literature).⁹

Jo (2017) also uses HEI as a measure for diet quality and finds that HEI scores for households with obese children do not differ significantly than those of households without obese children. However, analyzing FoodAPS data, the author determines that children from households with at least one obese child tend to live in more disadvantaged households and food environments than children from households without any obese children. Parents with obese children are more likely to be unmarried, less educated, financially constrained, and obese themselves. Furthermore, households with obese children tend to be located in areas with lower access to supermarkets and healthful foods. Understanding factors that may explain high obesity rates among children is critical for any efforts seeking to curtail the growing and costly public health crisis of childhood obesity.

⁹Body mass index (BMI) is the most common measure of obesity and is a function of height and weight.

Food Assistance Programs

The cornerstone of food and nutrition assistance programs for low-income households in the United States is SNAP. The benefits are designed to increase the food purchasing power of program participants and provide them with sufficient funds to adhere to the Thrifty Food Plan (TFP), a USDA plan that outlines a nutritious diet at a minimal cost to households. Given the significant federal investment of \$68 billion in fiscal year 2017 (Oliveira 2018), there is a considerable need to understand the food expenditures of households that participate in the SNAP program. Addressing this need, Tiehen, Newman, and Kirlin (2017) compare food expenditure patterns of SNAP households with those of eligible nonparticipant households and households overall using FoodAPS data. After adjusting for household size and composition, these authors find that the food expenditures of SNAP households are lower than those of other U.S. households, including households whose income and assets are low enough to qualify them for SNAP benefits. This finding is consistent with other recent research that finds SNAP households are more likely than eligible nonparticipant households to spend less on food per year than the cost of the TFP (Hoynes, McGranahan, and Schanzenbach 2015). Additionally, FAH spending accounts for almost three-fourths of total food expenditures for SNAP households, a greater share than that of other U.S. households. Although SNAP households generally spend less on food purchases compared to other households, Mancino et al. (2018) find that the average acquired calories per adult equivalent is similar between SNAP and non-SNAP households, suggesting that SNAP households devote less of their food dollars to purchases from restaurants and other FAFH sources, and instead rely more on school meals and family and friends. For FAH, SNAP households may visit lower-priced stores or buy a different mix of calorie-dense foods to stretch their food budgets.

SNAP benefit amounts are based on an assessment of need that takes into account household size, income, and adjustments to income. SNAP benefits are also legislated at a national level (with the exception of Alaska and Hawaii), and therefore, regional food price variation can potentially affect the ability of SNAP households to adhere to the TFP (see Todd, Leibtag, and Penberthy 2011; Gregory and Coleman-Jensen 2013; Oliveira et al. 2018; Waxman, Gundersen, and Thompson 2018). Investigating the impact of regional food price variation using FoodAPS data, Bronchetti, Christensen, and Hansen (2016) determine that 20% to 30% of SNAP households face TFP prices that are too high to be purchased with SNAP benefits plus 30% of net income. For those households that cannot afford the TFP, the average dollar shortfalls are approximately \$150 per month. However, SNAP sufficiency rates increase substantially as the distance within which the household is assumed to be able to shop is expanded. Similarly, Lyford et al. (2016) examine the impact of regional food prices on the purchasing power of SNAP benefits, and find that, after controlling for regional food market structure (e.g., number of competitors in the market) and consumer shopping habits (e.g., budgeting), SNAP participation does not have a significant impact on the prices households pay for food items.

In addition to regional food price variation, the timing of benefits can potentially affect the behavior of recipients and the effectiveness of SNAP (Todd 2015). Recent analyses of FoodAPS data reveal a clear temporal

pattern in the food expenditures of SNAP households across the benefit month (Smith et al. 2016; Tiehen, Newman, and Kirlin 2017; Dorfman et al. 2018; Kuhn 2018). On the days immediately following SNAP benefit receipts, average daily food expenditures are significantly higher than the rest of the month, with average food spending declining sharply over the benefit month. In fact, within the first four days of receiving SNAP benefits, 39% of SNAP recipients will spend, on average, approximately two-thirds of their monthly benefits (Dorfman et al. 2018). And according to Kuhn (2018), expenditures decline by an average of \$2.07 per day over the course of the benefit month. However, children, especially young children, are mostly insulated from cyclical food shortages due to parental care and the availability of school meals. Similarly, Whiteman, Chrisinger, and Hillier (2018) find that diet quality, as measured by HEI scores, also declines over the course of the benefit month, with a significant drop in diet quality in the final 10 days of the benefit cycle. Smith et al. (2016) further explore the behavioral responses that may drive the SNAP benefit cycle: short-run impatience (i.e., a higher preference to consume today) and fungibility of income (i.e., the degree of substitutability between a SNAP dollar and a cash dollar). Analyzing FoodAPS data, the authors find evidence of both behavioral responses.

Another pivotal food and nutrition assistance program overseen by FNS is the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC). WIC is a nutrition assistance program for low-income pregnant women, breastfeeding women, and infants and children under the age of five. The central mission of WIC is to safeguard the health of participants by providing nutrition education, referrals to health care, and a monthly package of healthful supplemental foods. WIC participants will typically receive vouchers that they can exchange for approved foods such as infant formula, fluid milk, and whole grain cold cereal, at authorized retail stores. Evaluating the impact of WIC using FoodAPS data, Stewart et al. (2018) find that on average, WIC households acquire more whole grains from bread than eligible nonparticipant households (consistent with the findings of Oh, Jensen, and Rahkovsky 2016), but did not detect any difference in the amount of whole grains acquired from cold cereal. Since participants incur no additional expenses on approved food items, they may also be less price-sensitive when choosing between options. Analyzing purchases of cold cereals by FoodAPS households, Dong et al. (2016) find that WIC households are in fact less price sensitive when making cereal decisions using WIC benefits, but more price sensitive when paying out of pocket.

Food Environment

Access to food retailers with adequate inventories of healthful and nutritious foods has emerged as one of the top public health and food policy concerns (Ver Ploeg et al. 2009). How households travel, how far they travel, and what stores they ultimately choose to shop from is of particular policy interest, especially for low-income and food-insecure households. FoodAPS data provide a unique opportunity to examine where households usually complete their grocery shopping, and how their food environment affects food acquisitions, food security, and diet quality (Ver Ploeg, Dutko, and Breneman 2015a).

In terms of transportation and distance, Ver Ploeg et al. (2015b) find that 88% of all households use their own vehicle to get to the store where they do most of their grocery shopping (i.e., their primary store), while only 66% of SNAP households use their own vehicle. These authors also find that, on average, a household's primary store is 3.8 miles away, even though the average distance to the nearest SNAP-authorized supermarket or supercenter is 2.2 miles away. Thus, other factors, such as food prices and quality of produce, may play a larger role in grocery store selection other than just proximity. Along those lines, Hillier et al. (2017) find that store size, whether or not a store is a full-service supermarket, and driving distance from the home are the three main determinants of store choice. And overall, households are more likely to choose larger, conventional supermarkets over other store types, including supercenters such as Walmart and Target. In fact, during a typical week, 88% of higher income households and 83% of SNAP households and other lower-income households acquired food from a large grocery store (Todd and Scharadin 2016).

Suggesting that some low-income households may have difficulty accessing large grocery stores, Ver Ploeg, Larimore, and Wilde (2017) find that 6% of U.S. households are access-burdened (i.e., they live more than 0.5 miles from the nearest SNAP-authorized supermarket or supercenter *and* do not have their own vehicle to travel to the store for groceries). About 77% of these households visit a supermarket, supercenter, or large grocery store during an average week, compared to 87% of households with sufficient access to large food retailers (i.e., living within 0.5 mile of the nearest supermarket or supercenter *or* use their own vehicle to travel to the store). Access-burdened households that visit these large stores average slightly fewer shopping events per week compared to households with sufficient access, but spend a similar percentage of their total food expenditures at large stores compared to other households.

Access to large grocery stores, particularly SNAP-authorized stores, is of great policy relevance because these stores generally have a wider selection of healthy foods. As demonstrated using FoodAPS data, low-income households tend to have a higher risk of uncertain or low access to large grocers that sell a wide variety of healthy foods (Ver Ploeg et al. 2015b; Todd and Scharadin 2016; Ver Ploeg, Larimore, and Wilde 2017) and may also face higher food prices (Fan et al. 2018). Therefore, low-income households residing in areas with limited food access (often referred to as food deserts) may also have an increased risk of poor nutrition and chronic diet-related disease. Analyzing FoodAPS data, Gustafson et al. (2016) show that SNAP households purchase higher quantities of fruits and vegetables when they shop at supermarkets and supercenters compared to when they shop convenience stores, and Bowen et al. (2016) similarly find that higher numbers of large grocers in a neighborhood are positively associated with better diet quality.

Several researchers have also investigated the impact of other food environment factors, such as regional food and rent prices, on outcomes such as food acquisitions, food security, and diet quality (see Basu, Wimer, and Seligman 2016; Downing and Laraia 2016; Lyford et al. 2016; Taylor and Villas-Boas 2016). Downing and Laraia (2016) find that households living in neighborhoods with high food costs are more likely to be food insecure. And Basu, Wimer, and Seligman (2016) find that living in a county with high rent costs is correlated with fewer fruit, vegetable, and whole grain

food acquisitions. However, households participating in SNAP that reside in high-cost counties have slightly improved nutritional outcomes, providing some supportive evidence for the sufficiency of SNAP benefits in achieving nutrition policy goals.

Challenges and Future Directions

Future rounds of FoodAPS data collection will undoubtedly benefit from the lessons learned from designing and implementing a comprehensive survey collecting high-quality data on the foods acquired by American households. The challenges and obstacles encountered have been documented by a number of articles, including the following: the five evaluation reports previously mentioned (Krenzke and Kali 2016; Li, Van de Kerckhove, and Krenzke 2016; Maitland and Li 2016; Petraglia, Van de Kerckhove, and Krenzke 2016; Yan and Maitland 2016); a report prepared by Mathematica, the original FoodAPS contractor (Cole and Baxter 2016); a journal article outlining the lessons learned (Kirlin and Denbaly 2017); and other methodological studies (e.g., Hu et al. 2017). The most fundamental challenges in collecting FoodAPS data include response burden and response rates, response fatigue and underreporting, confirming SNAP participation, measuring income, food identification, and technology limitations. Understanding these challenges and limitations will be of great value to both users of the FoodAPS data, as well as other survey developers and managers.

Response Burden and Response Rates

Response burden posed a significant challenge for FoodAPS because the survey was complex in nature and required substantial input and time from respondents. The consent form informed households that participation in the survey might take four to six hours during the week, depending on household size. This notification likely contributed to 17% of households declining to participate after being deemed eligible for the survey. Another 22.6% of eligible households agreed to participate but dropped out before completing the initial interview. Most of this attrition occurred after interviewers trained respondents on how to record and report information about food acquisitions. In this case, learning what the survey actually entailed seriously affected the overall, weighted response rate of 41.5%.¹⁰

The low response rate for FoodAPS raises concerns about the potential for nonresponse bias, especially as the respondents to FoodAPS differed significantly from non-respondents along several socioeconomic characteristics. In particular, higher response rates were associated with SNAP participation and low-income status. However, there is some evidence to suggest that adjustments to the sample weights reduced the impact of potential nonresponse bias (Petraglia, Van de Kerckhove, and Krenzke 2016). Nevertheless,

¹⁰For comparison, Czajka and Beyler (2016) report overall (unconditional) response rates of 33% in the National Household Education Survey (2007); 69% in the Survey of Consumer Finances (2010); and 70% in the General Social Survey (2006). These are all national, cross-sectional surveys. For a more burdensome survey with a diary or booklet component similar to FoodAPS, BLS reports conditional response rates of 69.5% for the interview component and 67.8% for the diary component of the 2012 CE. Unconditional response rates were, respectively, 56.5% and 54.3%, based on author calculations of information provided in reported tables (U.S. Department of Labor 2016).

finding ways to increase participation and reduce response burden while continuing to collect the requisite data will remain a challenge.

Response Fatigue and Underreporting

Underreporting of purchased and acquired foods can occur in different ways in a food-diary survey like FoodAPS. First, a household member might simply refuse to cooperate with the survey throughout the entire week. Second, a member might report on some days, but refuse on others (e.g., under response fatigue, the likelihood of not reporting increases throughout the week). Third, for any given day of the data collection week, a member might report some but not all acquisition events. Finally, a member might correctly report a food acquisition event but fail to report all of the food items that were acquired, either through oversight or by intention. For all but the first mechanism, there may be systematic variation in what events or food items do not get reported. For instance, a member might report the following: all FAH events, but not FAFH events; all foods purchased, but not foods acquired for free; or all healthy foods, but not unhealthy foods. With so many potential sources of underreporting, reducing the amount of underreporting in FoodAPS surveys, or even understanding how big a problem it might be, is a significant challenge.

FoodAPS attempted to minimize underreporting by designating one person, the PR, to be responsible for collecting information about acquisition events from all household members and reporting this information during three scheduled phone calls with the survey's telephone center. Paradata from the survey indicate, by person-day, whether at least one event was reported, whether the PR confirmed that a member had no events, or whether the member refused to provide information. Finally, there are some person-days for which no events were reported, but the PR could not confirm that no event occurred.¹¹ These paradata allow one to examine the first two potential sources of underreporting, outright and selective refusal, but only the prevalence of refusals can be monitored with these data. There is no direct means of estimating how many events and food items went unreported, to say nothing of where the events occurred or the nutrient characteristics of the acquired foods.

FoodAPS also sought to reduce underreporting by incentivizing cooperation with the survey. As part of the incentive package, FoodAPS offered gift cards to household members if they completed their food diaries for each day (a positive affirmation of no acquisitions counted as participation). Nonetheless, subsequent evaluation of the data still found evidence of possible underreporting of food acquisitions (Maitland and Li 2016). Larger households (greater than 4 persons) reported fewer food acquisitions on a per person basis than did smaller households. In addition, the percentage of households that did not report any daily food expenditures increased over the course of the data collection week, suggesting response fatigue to the survey. Several sociodemographic factors including race, ethnicity, and education were related to the likelihood of reporting a food acquisition. Those who had a weaker connection to the household, such as nonrelatives of the PR, were also less likely to report on their food acquisitions.

¹¹The absence of confirmation could have occurred if the scheduled phone call was missed or if the PR did not have access to a household member's food book at the time of the phone call.

Separately, [Hu et al. \(2017\)](#) modeled the likelihood of a household member refusing to participate on a given day of the week using paradata from FoodAPS. These authors found that the marginal probability of a refusal increased over the week for members of households that began their data collection week on a Friday or Sunday, but not for the other days. Male and non-English-speaking PRs, and PRs in larger households, households that eat together less often, households with frequent guests, and households experiencing difficult financial conditions reported a significantly more difficult time getting other household members to participate in the survey.

Relating to foods acquired for free, [Weinfield et al. \(2014\)](#) estimates that one in seven Americans (14.2%) utilize charitable feeding programs such as soup kitchens or food pantries, but only 6.7% of FoodAPS participants reported visiting a food pantry in the 30 days prior to the survey. Stigma and terminology inconsistencies (i.e., regional variation in the use of food-pantry, -bank, and -shelf) may therefore be contributing to the apparent underreporting of charitable food, and future rounds of FoodAPS data collection will need to pay extra attention to how questions are worded so as to improve estimates of charitable food use.

Two major lessons emerge with regard to underreporting in FoodAPS. First, even though research by [Clay et al. \(2016\)](#) showed that captured food spending in FoodAPS was higher than in CE, measurement error still exists, and more work is needed to understand why and how underreporting of acquired food occurs—as well as its extent. Second, in order to support this needed research, more attention needs to be paid during survey design on how to generate the information needed for analysis. Conducting more recall interviews in future surveys would provide one valuable source of information, but this would also increase response burden. Comparing reported food items to items listed on associated receipts is another possibility. One researcher even suggested identifying missed food events by reviewing the GPS data in respondents' cell phones to see if they stopped at known food vendor locations during the week. Although this last approach is clearly intrusive, it does show that some creativity may be needed in thinking about how to measure and understand this source of survey error.

Confirming SNAP Participation Status through Administrative Data Matching

State SNAP agencies in 20 of the 27 states in which FoodAPS data were collected provided copies of their SNAP participant files, and about 97% of surveyed households consented to have their responses matched to program administrative data. For the reduced sample of 3,479 households that both consented to data matching and resided in a state that provided an administrative file, 94.7% correctly reported their SNAP status based on administrative records, 1.3% inaccurately reported current SNAP participation (false positives), and 1.6% inaccurately reported no participation (false negatives). Of the 1,131 households in this reduced sample with confirmed SNAP participants, 12.1% failed to report their participation.

To assess the accuracy of SNAP indicators, [Maitland and Li \(2016\)](#) first imputed the likelihood of SNAP participation for households in states that did not provide an administrative file. These authors then modeled the relationship between SNAP participation and several outcome measures of interest (e.g., total FAH expenditures, food security, and the PR's

self-assessment of diet quality) by first using self-reports of SNAP participation and then by a measure based on administrative data (including imputed values). The results suggest that efforts to confirm SNAP participation through matching to administrative data do not appear to affect analyses of SNAP impacts. Thus, future surveys may save time and money and reduce the burden on state agencies if these research findings are indeed corroborated.

Several teams of researchers are currently using FoodAPS data to investigate the prevalence of SNAP misreporting, which households are most likely to misreport their participation, and how misreporting affects research results. Although not yet published, some of this research does seem to find differences in estimates of SNAP effects depending on whether or not the measure of SNAP participation is confirmed through data matching. Thus, it appears that the efficacy of administrative data matching in this context remains an open question, at least with regard to self-reports of SNAP participation.

Measuring Income

Household income is a key measure for FoodAPS for several reasons. First, in any model of household food demand, income (and income transfers) provides a budget constraint on utility. If income is not accurately measured, any estimated impacts of other factors on food demand may be biased. Second, eligibility for food assistance programs like SNAP and WIC is based, in part, on income, and the formula for calculating the monthly SNAP benefit amount employs income measures. A central objective of FoodAPS has been to compare food demand of SNAP households to the food demand of SNAP-eligible households that do not participate in the program. Without accurate measurement of household income, there will be errors in estimating program eligibility of non-participants. Finally, to enable the comparisons just mentioned, a survey must include enough households in each group to allow reasonably accurate estimates of within-group food demand.

To determine a household's eligibility to participate in FoodAPS, screening interviews were conducted to collect information about household size, income, and SNAP participation. However, many FoodAPS households underreported total income during the screening interview. Because FoodAPS oversampled low-income households, the underreporting often led to incorrect assignment of households to sample domains which, in turn, had two negative impacts on the sample. It reduced the number of non-SNAP, low-income households in the sample, and it caused the variance of household weights within sample domains to increase, thereby reducing effective sample sizes in each sample domain.

Mathematica tried to improve the screener measurement of income midway through the survey by listing all possible income sources to be considered, but this had no measureable effect. It is unclear whether the problem is getting the respondent to reveal sensitive information about the household, to recognize the many different sources of income, or to include income of all household members. Regardless, if a survey's sample domains are to be income-dependent, research into a better approach for capturing accurate income data with a screener interview is needed.

Food Identification

The core of FoodAPS is capturing information on what foods are being purchased and acquired by American households, in what quantity, at what price, and from where. Once food items were identified, nutrient information was appended from several USDA nutrient databases. To do so, however, required a precise item description to serve as a common identifier in both sets of data. For FAH items, FoodAPS respondents used handheld scanners to scan UPCs and project-specific barcodes for random-weight items (e.g., fresh produce and bulk items without UPCs), and for other items respondents were asked to record a description of the item, the unit size, and the quantity acquired. Nearly 59% of FAH item descriptions came from matching with a UPC database; another 16% were from the respondent scanning a project-specific random-weight barcode; 20% were extracted from saved food receipts; and about 4% were based on respondent descriptions.

FAFH items represented a challenge quite different from FAH items as these items could not be scanned. Anticipating this challenge, the survey design included three recall interviews during the data collection week. That is, instead of relying solely on FAFH entries in food books, the PR was asked to speak to a telephone interviewer on the second, fifth, and final day of the reporting week. These three interviews first collected data about all events reported by household members since the last contact, but then focused on collecting information about FAFH food items and prices. To assist with these interviews, the telephone interviewer had access to menus from the most popular restaurants in the country. The plan was to use these menus to help clarify what respondents were reporting and to better identify bundled foods (e.g., whether sides were included with a reported entrée). Ultimately, for FAFH item descriptions, 41% were obtained from drop-down generic menus used by the interviewer during the phone interviews, 43% were based on open-ended respondent descriptions, and 16% were from matches to a database of restaurant menus. As [Cole and Baxter \(2016\)](#) note in their lessons learned report, the challenges for collecting and processing FAFH data persisted because: (a) the telephone interviews relied on respondent recall ability, (b) the variety of places where FAFH is acquired, (c) the variety of food items acquired, (d) the low rates of saved receipts, and (e) the fact that FAFH meals are not packaged and labeled with size and content information.

Given that many FAH and FAFH items did not match to an external database and that written descriptions can often be vague, future rounds of FoodAPS hope to significantly improve the identification of food items through the use of improved technology and investments in food product databases. Specifically, with regards to FAH, the use of web-based data collection methods (e.g., smartphones with barcode scanning capabilities) will allow for real-time food item identification once a barcode is scanned. If a scanned item is not recognized, the respondent may answer a series of questions and prompts to precisely describe the food item. With the constant introduction of new food products into the marketplace, however, the challenge of identifying all acquired foods will remain.

Technological Limitations

Other challenges encountered during FoodAPS data collection were related to technological limitations. With the exception of barcode scanning,

food acquisitions and purchases were largely reported using paper-and-pencil instruments. However, as Cole and Baxter (2016) observe, these challenges must be viewed in the context of the time period in which the study was designed. That is, “the data collection procedures were designed in 2009, just two years after the iPhone was introduced and one year before the iPad.” While it is certainly useful to keep these technical limitations in mind when looking back and considering data quality in FoodAPS, it is perhaps just as important to look forward and recognize the potential that advances in technology may have to simplify future data collection. Future rounds of FoodAPS data collection will benefit from some of these advances, resulting in improved data quality, lower response burden, and increased response rates.

Conclusion

The growing movement to use data-driven and evidence-based approaches to design, implement, evaluate, and improve federal programs and policies underscores the need for quality data like FoodAPS, an innovative study that links nationally-representative household survey data on food purchases and acquisitions with SNAP administrative data, USDA nutrient data, and geographic data related to food access and the food environment. Since their release, FoodAPS data have supported critical research on American food choices and diet quality, the efficacy of food assistance programs, and the role of the local food environment in shaping household food acquisitions. In upcoming years, we expect that these data will support many more studies. However, an ever-shifting food landscape means that new data will need to be collected if future research results are to be timely, practicable, and relevant to those who shape food and nutrition policy and manage food assistance programs. The challenges encountered with the original FoodAPS data collection will ultimately inform and improve the next round of data collection. These challenges include the following: response burden and nonresponse bias; response fatigue and underreporting; confirming SNAP participation; measuring income; accurate food identification; and technology limitations. To address these challenges, future data collection efforts must carefully consider and ultimately weigh the inherent tradeoff between improving the accuracy and completeness of the collected data and increasing response rates, reducing nonresponse bias and response burden, and lowering overall data collection and processing costs.

References

- Basu, S., C. Wimer, and H. Seligman. 2016. Moderation of the Relation of County-Level Cost of Living to Nutrition by the Supplemental Nutrition Assistance Program. *American Journal of Public Health* 106 (11): 2064–70.
- Bollinger, C.R., and M.H. David. 1997. Modeling Discrete Choice with Response Error: Food Stamp Participation. *Journal of the American Statistical Association* 92 (439): 827–35.
- . 2001. Estimation with Response Error and Nonresponse: Food Stamp Participation in the SIPP. *Journal of Business and Economic Statistics* 19 (2): 129–41.
- Bowen, S., R. Winkler, J.D. Bloom, and L. MacNeill. 2016. *Contextualizing Family Food Decisions: The Role of Household Characteristics, Neighborhood Deprivation, and Local*

- Food Environments*. Discussion Paper 2016–08, University of Kentucky Center for Poverty Research.
- Bronchetti, E., G. Christensen, and B. Hansen. 2016. *Variation in Food Prices and SNAP Adequacy for Purchasing the Thrifty Food Plan*. Discussion Paper 2016–03, University of Kentucky Center for Poverty Research.
- Clay, D.M., M. Ver Ploeg, A. Coleman-Jensen, H. Elitzak, C. Gregory, D. Levin, C. Newman, and M. Rabbitt. 2016. *Comparing National Household Food Acquisition and Purchase Survey (FoodAPS) Data with Other National Food Surveys' Data*. Washington DC: U.S. Department of Agriculture, Economic Research Service, Economic Information Bulletin No. 157.
- Cole, N., and C. Baxter. 2016. *Lessons Learned from the National Household Food Acquisition and Purchase Survey (FoodAPS)*. Prepared for the Economic Research Service, U.S. Department of Agriculture.
- Coleman-Jensen, A., M. Rabbitt, C. Gregory, and A. Singh. 2018. *Household Food Security in the United States in 2017*. Washington DC: U.S. Department of Agriculture, Economic Research Service, Economic Research Report No. 256.
- Czajka, J., and A. Beyler. 2016. *Declining Response Rates in Federal Surveys: Trends and Implications*. Background Paper, Mathematica Policy Research.
- Dietary Guidelines Advisory Committee. 2015. *Scientific Report of the 2015 Dietary Guidelines Advisory Committee: Advisory Report to the Secretary of Health and Human Services and the Secretary of Agriculture*. Washington DC: U.S. Department of Agriculture, Agricultural Research Service.
- Dong, D., H. Stewart, E. Frazao, A. Carlson, and J. Hyman. 2016. *WIC Household Food Purchases Using WIC Benefits or Paying Out of Pocket: A Case Study of Cold Cereal Purchases*. Washington DC: U.S. Department of Agriculture, Economic Research Service, Economic Research Report No. 207.
- Dorfman, J.H., C. Gregory, Z. Liu, and R. Huo. 2018. Re-Examining the SNAP Benefit Cycle Allowing for Heterogeneity. *Applied Economic Perspectives and Policy*.
- Downing, J., and B. Laraia. 2016. *Supermarket Proximity and Price: Food Insecurity and Obesity in the United States*. Discussion Paper 2016–05, University of Kentucky Center for Poverty Research.
- Fan, L., K. Baylis, C. Gundersen, and M. Ver Ploeg. 2018. Does a Nutritious Diet Cost More in Food Deserts? *Agricultural Economics* 49 (5): 587–97.
- Gregory, C., and A. Coleman-Jensen. 2013. Do High Food Prices Increase Food Insecurity in the United States? *Applied Economic Perspectives and Policy* 35 (4): 679–701.
- Gundersen, C. 2015. SNAP and Obesity. In *SNAP Matters: How Food Stamps Affect Health and Well Being*, ed. J. Bartfeld, C. Gundersen, T. Smeeding, and J. Ziliak, 161–85. Redwood City, CA: Stanford University Press.
- Gundersen, C., B. Kreider, and J. Pepper. 2011. The Economics of Food Insecurity in the United States. *Applied Economic Perspectives and Policy* 33 (3): 281–303.
- Gundersen, C., and J.P. Ziliak. 2018. Food Insecurity Research in the United States: Where We Have Been and Where We Need to Go. *Applied Economic Perspectives and Policy* 40 (1): 119–35.
- Gustafson, A., J.E. Allen, N. Schoenberg, and M. Swanson. 2016. *The Relationship between Neighborhood Food Environment and Food Store Choice on Purchasing Habits among SNAP and Lower Income Households*. Discussion Paper 2016–09, University of Kentucky Center for Poverty Research.
- Hillier, A., T.E. Smith, E.D. Whiteman, and B.W. Chrisinger. 2017. *Discrete Choice Model of Food Store Trips Using National Household Food Acquisition and Purchase Survey (FoodAPS)*. *International Journal of Environmental Research and Public Health* 14 (10): 1133.
- Hoynes, H.W., L. McGranahan, and D.W. Schanzenbach. 2015. SNAP and Food Consumption. In *SNAP Matters: How Food Stamps Affect Health and Well Being*, ed. J. Bartfeld, C. Gundersen, T. Smeeding, and J. Ziliak, 107–133. Redwood City, CA: Stanford University Press.

- Hu, M., G.W. Gremel, J.A. Kirlin, and B.T. West. 2017. Nonresponse and Underreporting Errors Increase over the Data Collection Week Based on Paradata from the National Household Food Acquisition and Purchase Survey. *The Journal of Nutrition* 147 (5): 964–75.
- Jo, Y. 2017. *The Differences in Characteristics among Households With and Without an Obese Child: Findings from USDA's FoodAPS*. Washington DC: U.S. Department of Agriculture, Economic Research Service, Economic Information Bulletin No. 179.
- Kirlin, J.A., and M. Denbaly. 2017. Lessons Learned from the National Household Food Acquisition and Purchase Survey in the United States. *Food Policy* 72: 62–71.
- Krenzke, T., and J. Kali. 2016. *Review of the FoodAPS 2012 Sample Design*. Prepared for the Economic Research Service, U.S. Department of Agriculture.
- Kuhn, M.A. 2018. Who Feels the Calorie Crunch and When? The Impact of School Meals on Cyclical Food Insecurity. *Journal of Public Economics* 166: 27–38.
- Li, J., W. Van de Kerckhove, and T. Krenzke. 2016. *Review of the FoodAPS 2012 Imputation Approaches for Income and Price Data*. Prepared for the Economic Research Service, U.S. Department of Agriculture.
- Lyford, C., R.J. March, C.E. Carpio, and T. Boonsaeng. 2016. *Do SNAP Recipients Get the Best Prices?* Discussion Paper 2016–07, University of Kentucky Center for Poverty Research.
- Mabli, J., and R. Malsberger. 2013. Recent Trends in Spending Patterns of Supplemental Nutrition Assistance Program Participants and Other Low-Income Americans. In *Monthly Labor Review*. U.S. Bureau of Labor Statistics. <https://stats.bls.gov/opub/mlr/2013/article/pdf/mabli-malsberger.pdf>
- Maitland, A., and L. Li. 2016. *Review of the Completeness and Accuracy of FoodAPS 2012 Data*. Prepared for the Economic Research Service, U.S. Department of Agriculture.
- Mancino, L., J. Guthrie, M. Ver Ploeg, and B.H. Lin. 2018. *Nutritional Quality of Foods Purchased and Acquired by Americans: Findings from USDA's National Household Food Acquisition and Purchase Survey*. Washington DC: U.S. Department of Agriculture, Economic Research Service, Economic Information Bulletin No. 188.
- Meyer, B.D., and R.M. Goerge. 2011. *Errors in Survey Reporting and Imputation and their Effects on Estimates of Food Stamp Program Participation*. CES 11–14, Center for Economic Studies, U.S. Census Bureau.
- Meyer, B.D., W.K.C. Mok, and J.X. Sullivan. 2009. *The Under-Reporting of Transfers in Household Surveys: Its Nature and Consequences*. NBER Working Paper No. 15181, National Bureau of Economic Research.
- Muth, M.K., M. Sweitzer, D. Brown, K. Capogrossi, S.A. Karns, D. Levin, A. Okrent, P. Siegel, and C. Zhen. 2016. *Understanding IRI Household-Based and Store-Based Scanner Data*. Technical Bulletin No. 1942. Washington DC: U.S. Department of Agriculture, Economic Research Service.
- National Research Council. 2005. *Improving Data to Analyze Food and Nutrition Policies*. Washington, DC: The National Academies Press.
- Oh, M., H.H. Jensen, and I. Rahkovsky. 2016. Did Revisions to the WIC Program Affect Household Expenditures on Whole Grains? *Applied Economic Perspectives and Policy* 38 (4): 578–98.
- Oliveira, V. 2018. *The Food Assistance Landscape: FY2017 Annual Report*. Washington DC: U.S. Department of Agriculture, Economic Research Service, Economic Information Bulletin No. 190.
- Oliveira, V., M. Prell, L. Tiehen, and D. Smallwood. 2018. *Design Issues in USDA's Supplemental Nutrition Assistance Program: Looking Ahead by Looking Back*. Washington DC: U.S. Department of Agriculture, Economic Research Service, Economic Research Report No. 243.
- Petraglia, E., W. Van de Kerckhove, and T. Krenzke. 2016. *Review of the Potential for Nonresponse Bias in FoodAPS 2012*. Prepared for the Economic Research Service, U.S. Department of Agriculture.

- Rigdon, J., S.A. Berkowitz, H.K. Seligman, and S. Basu. 2017. Re-Evaluating Associations between the Supplemental Nutrition Assistance Program and Body Mass Index in the Context of Unmeasured Confounders. *Social Science and Medicine* 192: 112–24.
- Smith, T.A., J.P. Berning, X. Yang, G. Colson, and J.H. Dorfman. 2016. The Effects of Benefit Timing and Income Fungibility on Food Purchasing Decisions among Supplemental Nutrition Assistance Program Households. *American Journal of Agricultural Economics* 98 (2): 564–80.
- Stewart, H., P.W. McLaughlin, D. Dong, and E. Frazão. 2018. WIC Households' Bread and Cold Cereal Purchases: When They Use Benefits versus Paying out of Pocket. *American Journal of Health Promotion*. <https://journals.sagepub.com/doi/abs/10.1177/0890117118778243>.
- Taylor, R., and S.B. Villas-Boas. 2016. Food Store Choices of Poor Households: A Discrete Choice Analysis of the National Household Food Acquisition and Purchase Survey (FoodAPS). *American Journal of Agricultural Economics* 98 (4): 513–32.
- The U.S. Burden of Disease Collaborators. 2018. The State of U.S. Health, 1990–2016: Burden of Diseases, Injuries, and Risk Factors among U.S. States. *Journal of the American Medical Association* 319 (14): 1444–72.
- Tiehen, L., C. Newman, and J. Kirlin. 2017. *The Food Spending Patterns of Households Participating in the Supplemental Nutrition Assistance Program: Findings from USDA's FoodAPS*. Washington DC: U.S. Department of Agriculture, Economic Research Service, Economic Information Bulletin No. 176.
- Todd, J.E. 2015. Revisiting the Supplemental Nutrition Assistance Program Cycle of Food Intake: Investigating Heterogeneity, Diet Quality, and a Large Boost in Benefit Amounts. *Applied Economic Perspectives and Policy* 37 (3): 437–58.
- Todd, J.E., E. Leibtag, and C. Penberthy. 2011. Geographic Differences in the Relative Price of Healthy Foods. Washington DC: U.S. Department of Agriculture, Economic Research Service, Economic Information Bulletin No. 78.
- Todd, J.E., and B. Scharadin. 2016. *Where Households Get Food in a Typical Week: Findings from USDA's FoodAPS*. Washington DC: U.S. Department of Agriculture, Economic Research Service, Economic Information Bulletin No. 156.
- U.S. Department of Labor. 2016. *2015 Response Rates: Interview Survey and Diary Survey Consumer Expenditure Public Use Microdata*. Bureau of Labor Statistics, Division of Consumer Expenditure Survey.
- Ver Ploeg, M., V. Breneman, T. Farrigan, K. Hamrick, D. Hopkins, P. Kaufman, B. Lin, et al. 2009. *Access to Affordable and Nutritious Food: Measuring and Understanding Food Deserts and Their Consequences. Report to Congress*. Washington DC: U.S. Department of Agriculture, Economic Research Service, AP-036.
- Ver Ploeg, M.P., Dutko, and V. Breneman. 2015a. Measuring Food Access and Food Deserts for Policy Purposes. *Applied Economic Perspectives and Policy* 37 (2): 205–25.
- Ver Ploeg, M., E. Larimore, and P. Wilde. 2017. *The Influence of Food Store Access on Grocery Shopping and Food Spending*. Washington DC: U.S. Department of Agriculture, Economic Research Service, Economic Information Bulletin No. 180.
- Ver Ploeg, M., L. Mancino, J.E. Todd, D.M. Clay, and B. Scharadin. 2015b. *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*. Washington DC: U.S. Department of Agriculture, Economic Research Service, EIB-138.
- Waxman, E., C. Gundersen, and M. Thompson. 2018. *How Far Do SNAP Benefits Fall Short of Covering the Cost of a Meal?* Urban Institute Research Report.
- Weinfeld, N.S., G. Mills, C. Borger, M. Gearing, T. Macaluso, J. Montaquila, and S. Zedlewski. 2014. *Hunger in America 2014*. Prepared for Feeding America.
- Whiteman, E.D., B.W. Chrisinger, and A. Hillier. 2018. Diet Quality Over the Monthly Supplemental Nutrition Assistance Program Cycle. *American Journal of Preventative Medicine* 55 (2): 205–12.