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Nonresponse and Underreporting Errors Increase over the Data Collection Week Based on Paradata from the National Household Food Acquisition and Purchase Survey[1–4]

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Abstract

Background: Food acquisition diary surveys are important for studying food expenditures, factors affecting food acquisition decisions, and relations between these decisions with selected measures of health (e.g., body mass index, self-reported health). However, to our knowledge, no studies have evaluated the errors associated with these diary surveys, which can bias survey estimates and research findings. The use of paradata, which has been largely ignored in previous literature on diary surveys, could be useful for studying errors in these surveys.

Objective: We used paradata to assess survey errors in the National Household Food Acquisition and Purchase Survey (FoodAPS).

Methods: To evaluate the patterns of nonresponse over the diary period, we fit a multinomial logistic regression model to data from this 1-wk diary survey. We also assessed factors influencing respondents' probability of reporting food acquisition events during the diary process by using logistic regression models. Finally, with the use of an ordinal regression model, we studied factors influencing respondents' perceived ease of participation in the survey.

Results: As the diary period progressed, nonresponse increased, especially for those starting the survey on Friday (where the odds of a refusal increased by 12% with each fielding day). The odds of reporting food acquisition events also decreased by 6% with each additional fielding day. Similarly, the odds of reporting ≥1 food-away-from-home event (i.e., meals, snacks, and drinks obtained outside the home) decreased significantly over the fielding period. Male respondents, larger households, households that eat together less often, and households with frequent guests reported a significantly more difficult time getting household members to participate, as did non–English-speaking households and households currently experiencing difficult financial conditions.

Conclusions: Nonresponse and underreporting of food acquisition events tended to increase in the FoodAPS as data collection proceeded. This analysis of paradata available in the FoodAPS revealed these errors and suggests methodologic improvements for future food acquisition surveys. *J Nutr* 2017;147:964–75.

Keywords: paradata, National Household Food Acquisition and Purchase Survey, FoodAPS, food acquisition diary survey, survey errors, nonresponse error, measurement error

Introduction

Diary surveys collect data on activities and events of interest when or shortly after they occur (1), with the ideal goal of capturing day-to-day variation in outcomes and potentially minimizing recall errors. Diary surveys have been used in many fields, including economics, marketing research, sociology, health, and nutrition. The first nationally representative survey of household food purchases and acquisitions is the USDA's National Household Food Acquisition and Purchase Survey (FoodAPS),[7] which

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[7] Abbreviations used: CS, confirmed status of food acquisition; DSI, days since issuance of SNAP benefits; FAFH, food away from home; FAH, food at home; FoodAPS, National Household Food Acquisition and Purchase Survey; GIS, Geographic Information Systems; HR, household respondent; PR, primary respondent; SNAP, Supplemental Nutrition Assistance Program.

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collected data from households with the use of a 7-d diary survey in 2012 and 2013 (2). Despite the recent increased use of the FoodAPS data to study food expenditures (3–9) and its potential use in studying relations between these expenditures and selected health outcomes measured in the survey (e.g., BMI, self-reported health), no studies, to our knowledge, have evaluated the survey errors associated with a design like that used for the FoodAPS. Such errors may bias survey estimates. (See reference 10 for more ongoing research on FoodAPS). We examine 2 types of survey errors that are especially critical for FoodAPS in this study: nonresponse error and measurement (typically, underreporting) error, with a focus on the diary survey methodology.

Although previous research has contributed to our understanding of the different error sources in diary surveys, there are several noteworthy weaknesses in the existing literature. First and foremost, the majority of the literature on diary surveys has largely ignored the use of paradata (data describing the process of survey data collection, such as contact history data), which could help the study of survey errors (11). For example, paradata on respondents' daily reporting status (i.e., whether a respondent participated, refused, or did not have his or her responses confirmed for a particular day) can be used to study nonresponse patterns across the diary period. Another example of potentially informative paradata is respondents' feedback on the ease of the diary process, such as how difficult it was to keep track of food acquisition during the diary period. This feedback information is important because it describes the difficulty of the survey process for a particular household, which may differ by various characteristics, such as household size. To our knowledge, no previous studies have fully utilized this feedback information to assess potential improvements in diary survey methodology.

The second main weakness of diary survey methodology more generally is the lack of attention to respondents' survey-taking behavior over time in diary surveys, and whether particular household features or design strategies are associated with underreporting or lack of participation across the diary period. In a week-long diary survey, respondents may become fatigued and less motivated as the survey progresses. This type of fatigue can result in a higher likelihood of underreporting or refusal later in the diary period. Unfortunately, to our knowledge, no previous studies have examined this possibility. Studies of patterns in these outcomes have the potential to inform strategies for reducing bias in future studies of food acquisition behavior.

This article aims to address the following questions with the use of FoodAPS data:

- What are the patterns of nonresponse over a 1-wk diary period, and what factors can predict those patterns?
- What factors influence respondents' reporting of food acquisition events in this 7-d diary survey?
- What factors influence the primary respondents' feedback on the ease of the survey process?

Methods

Participants and data collection

A total of 14,317 individuals living in 4826 households responded to the FoodAPS survey, including Supplemental Nutrition Assistance Program (SNAP) households, low-income households not participating in SNAP, and higher income households (2). Briefly, households were selected through a multistage sample design. In the first stage, a stratified sample of 50 primary sampling units (defined as counties or groups of contiguous counties) was selected by using the probability proportional to size method. In the second stage, 8 secondary sampling units were selected by using the probability proportional to size within each of the 50 sampled primary sampling units. In the third stage, households were selected from a list of addresses on the basis of screener interviews. Additional detailed information regarding the sample design, the data collection process, and data quality control is available in the FoodAPS User's Guide (12).

Each participating household was asked to *1*) record food acquisition data for all members over a 7-d period with the use of a diary food book and *2*) report which meals and snacks each household member ate each day by filling out the Meals and Snacks form. The person who reported doing the most shopping for each household was the primary respondent (PR); the PR participated in 2 in-person interviews (before and after the 1-wk data collection period) and ≤3 telephone interviews. **Figure 1** shows the overview of the planned data collection process of the FoodAPS. On days 2, 5, and 7 of the week, telephone interviewers sought to ascertain each household member's food acquisition behavior during each day since the previous contact. In this article, we distinguish between the PR within a household and a given household respondent (HR) who is not the PR. The overall study response rate was 41.5% (13) (by using the RR3 calculation endorsed by the American Association for Public Opinion Research) (14).

Along with collecting rich multivariate data on respondents' demographic characteristics and socioeconomic context, the FoodAPS also collected information on food acquisitions from all sources from every household member for both at-home and away-from-home purchases (including food obtained free of charge, such as dinners at other homes, gifts, etc.). "Food-at-home" (FAH) represents all "food and drinks brought into the home" and used to prepare meals for consumption at home or elsewhere. The survey described "food-away-from-home" (FAFH) as "meals, snacks, and drinks you got outside the home," including prepared foods that are brought home or delivered (e.g., prepared foods that were purchased at grocery stores and take-out meals from markets) (12, p. 10). Additional examples of FAH and FAFH can be found in the diary survey instrument (15, p. 4).

One useful feature of the FoodAPS is the rich paradata on the survey process that it generated. The survey includes information on each household's feedback on the survey process, contact history data such as the number of calls made, and interviewers' records on the reporting status of each household member for each day of the diary survey period (e.g., whether or not a household member refused to provide information for a particular day). We take advantage of these paradata in this study to address our 3 research questions.

Outcome variables

Our study included 4 outcome variables: *1*) daily participation of PRs and HRs, *2*) FAH daily reporting status, *3*) FAFH daily reporting status, and *4*) PR feedback on the ease of the survey process. Daily participation of PRs and HRs was collected during the 3 planned telephone interviews, at which time interviewers asked each PR about household members' food acquisitions (including the PR) for each day since the previous contact. Possible responses were as follows: *1*) confirmed status of food acquisition (CS; a food acquisition was reported to the interviewer or no food acquisitions were reported and the PR confirmed that the member did not have any FAH or FAFH event that day), *2*) refusal (the PR reported that the household member refused to participate in the study on that day), and *3*) unconfirmed (no food acquisitions were reported, but the PR could not confirm this; e.g., the PR did not have the member's food book for reference). In our model of participation for both PRs and HRs, we used this daily reporting status as the dependent variable.

Indicators of FAH and FAFH events were constructed on the basis of reports provided in the diary book and confirmation obtained from PRs in the telephone interviews. The FAFH indicator is constructed on the basis of whether a paid FAFH event occurred, which excludes food obtained free of charge. Each of the reporting status variables has 2 categories: *1*) reported ≥1 at-home (or away-from-home) food acquisition event for a specific day in the diary period and *2*) reported no at-home (or away-from-home) food acquisition events for a specific day in the diary period. These variables are constructed from those with CS on a given day.

PR feedback on ease of the survey process was collected during a feedback survey administered after the final interview. (The unweighted response rate was 97.6% for the feedback survey). This variable

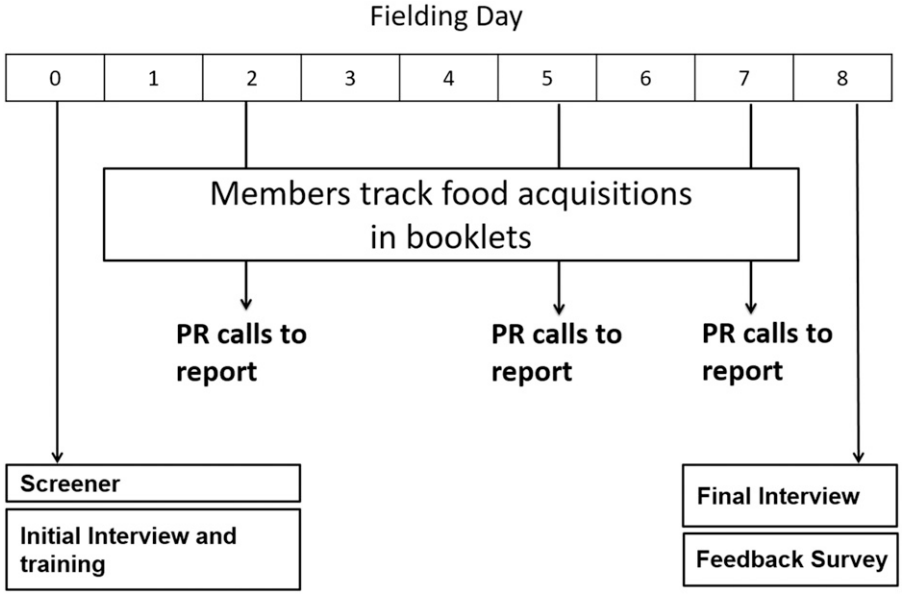

FIGURE 1 Overview of the planned data collection week of FoodAPS. Note that various situations prevented the plan from being followed strictly. FoodAPS, National Household Food Acquisition and Purchase Survey; PR, primary respondent.

describes the cooperation of other household members during the diary survey by asking, "How easy or difficult was it to get other household members to participate?" This was measured by using a 5-point Likert scale, ranging from "very easy" to "very difficult." This variable was defined only for households with ≥2 household members, and thus was not measured for the 1024 one-person households.

Covariates

Fielding day. We constructed fielding day as the actual numeric day of the 7-d period (coded as 1, 2, … 7), centered at the first day (i.e., the actual codes are 0, 1, 2, … 6).

Start date. We constructed start date on the basis of the actual day of the week (e.g., Monday) that each household started the survey. This classified households into 7 start-date cohorts (Sunday–Saturday).

Time gap. This time-invariant household-level variable was constructed on the basis of the time difference (measured in days) between the initial interview and the start date of the survey. Although each household was instructed to start the diary survey right after the first face-to-face interview, at which time the PRs were provided with detailed instructions, this unfortunately did not always occur. This means that the time gap variable differed across households.

Financial management variables. Household-level financial management variables were obtained during the final interview and included questions on how often bills were reviewed for accuracy, how often bills were paid on time, and whether a household had not paid rent or mortgage or utility bills on time in the previous 6 mo.

SNAP indicator. We constructed a days-since-issuance (DSI) SNAP status indicator on the basis of a SNAP status variable and DSI information, which is the number of days between the last time SNAP benefits were received by the household and the fielding day. This time-varying indicator included 5 categories: SNAP household with DSI ≤10, 11 ≤ DSI ≤20, or DSI ≥21; SNAP household but DSI unknown; and non-SNAP household.

BMI. BMI was calculated for each respondent on the basis of reported heights and weights collected during the final interview. It was categorized into 4 categories: not overweight, overweight, obese, and not applicable, missing, or error. The BMI categories for adults were based on WHO guidelines: BMI (in kg/m^2) <25 for not overweight, 25 ≤ BMI < 30 for overweight, and BMI ≥30 for obese (16). BMI categorizations for children and teens were based on CDC age- and sex-specific growth charts (17).

Call history paradata. Paradata of this type were collected during the telephone interviews, which included the number of inbound calls (at which time the PR called the survey's telephone center to report acquisition information) and outbound calls (at which time the telephone center called the PR) on a given day.

Additional covariates. Additional covariates (e.g., interview language, respondents' demographic characteristics and socioeconomic status, household-level characteristics such as household size) were also obtained during the survey process and from a comprehensive set of questionnaires administered at the initial and final interviews and feedback surveys.

Statistical analysis

To address our first research question, we fit a multinomial logistic regression model (model 1) to examine predictors of respondents' daily participation with the use of the Stata software (version 14; StataCorp). Daily reporting status was used as the dependent variable. The distribution for the reporting status variable was 86.0% confirmed (86,196 person-days), 4.1% refusals (4060 person-days), and 9.9% unconfirmed (9963 person-days). Because SNAP households and low-income households were oversampled in the survey, we followed the FoodAPS analytic guidelines (12, p. 20–28) and used sampling weights in our analyses so that the estimates would be representative of the general population of US households. We also accounted for the complex features of the FoodAPS sample design (stratification and cluster sampling) by using the codes representing sampling strata and clusters in Stata, which includes procedures that implement design-based linearized variance estimation methods by default (18). (More details on the models that were fit in this study are available in **Supplemental Methods** and **Supplemental Methodological Notes**).

To predict respondent participation and address the aforementioned gaps in knowledge, we included several key independent variables in this first model. First, to evaluate whether nonresponse patterns differed across the 7-d diary period, we included the fielding day as a covariate in the model. Second, because each household may have started the survey on a different day of the week (e.g., Monday), we included in the model the day of the week on which a household started. Third, to evaluate whether trends in nonresponse across the 7 d varied depending on the start date, we included an interaction between start date and centered fielding day in our model. Fourth, because larger households may find it more difficult to provide complete reports on a given day, we included

TABLE 1 Descriptions of the variables analyzed[1]

Model	Dependent variable	Time-varying covariates	Time-invariant covariates
Model 1	Daily reporting status (time-varying)	Household-level variables: Fielding day; interaction between start date and fielding day; DSI	Individual-level variables: BMI, sex, age, individual income, education, marital status, race, relationship with PR Household-level variables: Time gap between the initial interview and the start date of the survey; start-date cohort; feedback on the completion of meals and snacks forms; feedback on member participation; feedback on ease of keeping track of food; financial condition; how often bills are reviewed for accuracy; how often bills are paid on time; household size; total inbound calls and outbound calls
Model 2	FAH daily reporting status (time-varying)	Same as model 1	Same as model 1
Model 3	FAFH daily reporting status (time-varying)	Same as model 1	Same as model 1
Model 4	PR feedback on ease of the survey process (time-invariant)	NA	Household-level variables: Household size; presence of any guests coming for a meal or snack; a DSI SNAP household status indicator[2]; eligibility for the WIC; the household's reported financial condition; rural status; whether the respondent(s) own/rent the residential unit; number of meals together last week with other household member(s); interview language at final interview PR characteristics (also at the household level): PR sex, PR age, PR education, PR race

[1] DSI, days since issuance of SNAP benefits; FAFH, food-away-from-home; FAH, food-at-home; NA, not applicable; PR, primary respondent; SNAP, Supplemental Nutrition Assistance Program; WIC, Special Supplemental Nutrition Program for Women, Infants, and Children.
[2] Because the feedback model is only at the household level (not person-day), the DSI SNAP household status needs to be constructed as a time-invariant variable, where DSI at the first fielding day is used to construct the variable.

household size in our model. We also controlled for demographic variables and socioeconomic status, including each household member's sex, age, income, education, race, and marital status. Given that this model is fit to data at the person-day level, we included both time-variant and time-invariant covariates in our model of participation (see **Table 1**). Wald *F* tests were used to assess the overall significance of each covariate in the model.

Given that each household member had records for 7 d, we treated each individual as a cluster of correlated observations for variance estimation purposes. A variable containing the FoodAPS stratification codes was used to account for the stratified sample design used for FoodAPS. We also estimated the model variables by using the aforementioned sampling weights for each respondent to obtain national estimates of these population relations.

To answer our second research question and to examine general trends in food-reporting events within the surveyed week, we fit 2 logistic regression models to data from days with CS responses: one for FAH events (model 2) and 1 for FAFH events (model 3). The same set of covariates used in model 1 (participation) was used in these 2 models of food-reporting events. Similar to model 1 (for participation), each individual was treated as a cluster of correlated observations for variance estimation purposes. The aforementioned FoodAPS stratification codes and the final respondent weights were also included in the analysis to account for the complex sample design features.

To answer our third research question, we fit an ordinal logistic regression model (model 4) to examine predictors of each PR's feedback with the use of Stata. (We tested the proportional odds assumption allowing us to assume common regression parameters for each predictor and found that the assumption of proportional odds appeared to be violated. Refitting the model by using a more general multinomial modeling approach did not change any of the main inferences). This model was fit at the household level, with each observation in the data set representing a PR at a household with >1 household member. Household size and presence of any guests coming for a meal or snack are included as covariates in the PR feedback model, because the presence of more people in a household might make it harder for the PR to track food acquisition behavior for all members. See Table 1 for a full list of covariates included in this model. To account for the complex sample design of FoodAPS in this feedback model, variables capturing the complex sampling features, including the stratum codes, the sampling cluster codes (now capturing higher-level area clustering due to the household-level analysis), and the final weights for the PRs were used in the analyses.

Results

Model 1: predicting member participation

Table 2 presents results from the estimated multinomial logistic regression model (model 1). Among those who started on Friday, when fielding day increased by 1 unit, the odds of reporting a refusal compared with a CS increased by 12% (OR: 1.12; 95% CI: 1.07, 1.17). A 1-unit increase in fielding day also led to a 27% increase in the odds of unconfirmed status compared with a CS for those members who started on Friday (OR: 1.27; 95% CI: 1.20, 1.35). On the first day of the diary period, the odds of reporting a refusal over a CS were lower for the Sunday (OR: 0.47; 95% CI: 0.28, 0.81) and Saturday (OR: 0.40; 95% CI: 0.21, 0.75) start-date cohorts than for those household members in the Friday cohort. However, the odds of unconfirmed reports compared with a CS were higher for the Sunday (OR: 2.39; 95% CI: 1.42, 4.02) and Saturday (OR: 2.21; 95% CI: 1.47, 3.34) cohorts.

We also plotted the marginal predicted probabilities for each of the 3 levels of our dependent status variable as a function of fielding day and start date (see **Supplemental Figures 1–3**, **Supplemental Tables 1–3**). We note that, regardless of the cohort, the general trend was that the predicted probabilities of having an unconfirmed status increased over the fielding period. The Sunday and Monday cohorts had the largest increase in the predicted probability of an unconfirmed report when the last day of fielding was compared with the first day. However, the same

TABLE 2 Results from the multivariate multinomial logistic regression model for the association between a household member's survey participation status and household or household member characteristics[1]

Predictor variable	n[2]	OR (95% CI)[3]		P[4]
		Refusal	Unconfirmed	
Fielding day (centered)	98,015	1.12 (1.07, 1.17)	1.27 (1.20, 1.35)	
Start date				<0.0001
Sunday	11,690	0.47 (0.28, 0.81)	2.39 (1.42, 4.03)	
Monday	7434	0.66 (0.35, 1.23)	1.05 (0.63, 1.76)	
Tuesday	16,912	0.81 (0.50, 1.30)	1.05 (0.71, 1.57)	
Wednesday	16,436	1.09 (0.66, 1.79)	1.12 (0.74, 1.70)	
Thursday	15,883	0.87 (0.53, 1.42)	1.37 (0.92, 2.05)	
Saturday	13,307	0.40 (0.21, 0.75)	2.21 (1.47, 3.33)	
Friday (referent)	—	—	—	
Start date × fielding day (centered)				<0.0001
Sunday	11,690	0.98 (0.92, 1.05)	0.98 (0.88, 1.08)	
Monday	7434	0.89 (0.82, 0.96)	1.07 (0.97, 1.18)	
Tuesday	16,912	0.87 (0.82, 0.93)	0.99 (0.92, 1.07)	
Wednesday	16,436	0.89 (0.85, 0.94)	0.93 (0.87, 1.00)	
Thursday	15,883	0.92 (0.86, 1.00)	0.98 (0.91, 1.06)	
Saturday	13,307	0.94 (0.86, 1.02)	0.90 (0.83, 0.97)	
Friday (referent)	—	—	—	
BMI[5]				0.68
Overweight (25.0–29.9)	26,096	1.23 (0.87, 1.74)	1.07 (0.90, 1.28)	
Obese (≥30.0)	28,273	0.97 (0.68, 1.40)	1.06 (0.86, 1.29)	
NA, missing, or error	6587	1.11 (0.60, 2.04)	0.85 (0.63, 1.14)	
Not overweight (<24.9) (referent)				
Sex				
Male	46,480	1.09 (0.81, 1.47)	1.10 (0.95, 1.28)	
Female (referent)	—	—	—	
Age category				<0.0001
0–10 y	19,103	0.10 (0.05, 0.24)	0.92 (0.63, 1.34)	
11–15 y	8253	0.28 (0.14, 0.57)	0.63 (0.42, 0.96)	
16–20 y	7840	0.65 (0.34, 1.23)	0.93 (0.65, 1.35)	
21–30 y	15,589	1.22 (0.72, 2.08)	1.12 (0.85, 1.47)	
31–55 y	30,359	0.90 (0.58, 1.4)	1.09 (0.89, 1.34)	
>55 y (referent)	—	—	—	
Income (adjusted)	98,015	1.00 (1.00, 1.00)	1.00 (1.00, 1.00)	
Education				0.57
High school graduate but no college	34,692	0.94 (0.67, 1.32)	0.95 (0.78, 1.15)	
College graduate and above	19,558	0.84 (0.54, 1.31)	0.83 (0.66, 1.06)	
Below high school (referent)	—	—	—	
Marital status				0.06
Married	30,023	0.63 (0.41, 0.97)	0.93 (0.75, 1.16)	
Widowed	3605	0.77 (0.36, 1.66)	1.29 (0.81, 2.05)	
Divorced	9037	0.77 (0.45, 1.32)	0.69 (0.52, 0.93)	
Separated	2464	0.53 (0.23, 1.22)	1.10 (0.68, 1.78)	
Never married (referent)	—	—	—	
Race				<0.0001
Black/African American	14,791	2.05 (1.39, 3.00)	1.25 (1.04, 1.50)	
Other race	15,071	0.97 (0.67, 1.42)	1.53 (1.27, 1.83)	
Multiple races	2408	0.04 (0.01, 0.12)	2.40 (1.16, 4.97)	
White (referent)	—	—	—	
Relationship to primary respondent				<0.0001
Partner or children	50,729	71.43 (27.91, 182.83)	1.65 (1.36, 1.99)	
Other relatives	10,843	118.64 (44.91, 313.41)	2.13 (1.66, 2.72)	
Nonrelatives	3185	207.26 (75.96, 565.51)	1.95 (1.17, 3.28)	
Primary respondent (referent)	—	—	—	

(Continued)

TABLE 2 *Continued*

Predictor variable	n^2	OR (95% CI)[3]		P^4
		Refusal	Unconfirmed	
Time gap[6]	98,015	0.91 (0.72, 1.14)	1.03 (0.99, 1.07)	
Meals and snacks forms completed				<0.0001
<1, not every day	18,459	0.94 (0.69, 1.29)	1.14 (0.94, 1.37)	
Once before end	1911	0.51 (0.23, 1.14)	1.90 (1.39, 2.60)	
Once at end	3808	1.01 (0.62, 1.65)	0.90 (0.62, 1.30)	
Did not complete	4004	1.23 (0.69, 2.20)	2.20 (1.60, 3.03)	
Missing	4114	2.98 (1.64, 5.44)	2.77 (1.93, 3.97)	
Every day (referent)	—	—	—	
Member participation				<0.0001
Very difficult/difficult	10,444	14.42 (10.05, 20.68)	2.07 (1.64, 2.61)	
Neither easy nor difficult	16,212	2.85 (1.97, 4.13)	1.50 (1.20, 1.87)	
NA/missing	8071	13.97 (7.53, 25.93)	1.12 (0.75, 1.66)	
Very easy/easy (referent)	—	—	—	
Ease of keeping track of foods				<0.0001
Very difficult/difficult	7000	0.39 (0.24, 0.64)	1.14 (0.87, 1.49)	
Neither easy nor difficult	15,078	0.61 (0.43, 0.86)	1.16 (0.97, 1.38)	
Missing	3276	0.09 (0.03, 0.25)	1.15 (0.66, 2.01)	
Very easy/easy (referent)	—	—	—	
SNAP categories				<0.0001
0–10 DSI SNAP household	14,591	1.11 (0.76, 1.60)	1.27 (1.02, 1.57)	
11–20 DSI SNAP household	11,820	1.39 (0.94, 2.06)	0.95 (0.77, 1.16)	
21–31 DSI SNAP household	10,199	1.34 (0.75, 2.38)	0.94 (0.77, 1.16)	
SNAP household but DSI missing	504	11.14 (4.26, 29.16)	1.14 (0.70, 1.86)	
Non-SNAP household (referent)	—	—	—	
Financial condition				0.80
Without much difficulty	26,922	1.00 (0.65, 1.54)	0.94 (0.76, 1.16)	
Occasionally difficult	30,786	0.92 (0.58, 1.44)	0.92 (0.73, 1.15)	
Tough to make ends meet	22,673	1.12 (0.70, 1.80)	1.03 (0.80, 1.34)	
In over your head	6223	0.76 (0.38, 1.50)	0.87 (0.64, 1.19)	
Very comfortable and secure (referent)	—	—	—	
Bill review				<0.0001
Rarely	6839	1.56 (0.86, 2.81)	1.04 (0.75, 1.45)	
Sometimes	16,870	2.58 (1.49, 4.44)	1.06 (0.79, 1.42)	
Usually	15,610	0.88 (0.51, 1.52)	0.76 (0.56, 1.02)	
Always	47,586	1.15 (0.70, 1.87)	0.80 (0.61, 1.03)	
NA	763	0.99 (0.21, 4.61)	1.58 (0.81, 3.1)	
Never (referent)	—	—	—	
Pay bills on time				<0.0001
Rarely	3535	0.32 (0.07, 1.36)	0.44 (0.27, 0.72)	
Sometimes	15,029	0.36 (0.09, 1.52)	0.52 (0.34, 0.81)	
Usually	26,271	0.41 (0.10, 1.76)	0.72 (0.47, 1.11)	
Always	51,009	0.58 (0.14, 2.42)	0.66 (0.43, 1.01)	
Don't know/refused	378	0.03 (0.00, 0.31)	0.13 (0.04, 0.44)	
Never (referent)	—	—	—	
Household size	98,015	1.03 (0.97, 1.10)	1.05 (1.02, 1.09)	
Inbound calls	98,015	0.87 (0.79, 0.96)	0.41 (0.38, 0.45)	
Outbound calls	98,015	1.11 (1.02, 1.20)	1.07 (1.02, 1.12)	

[1] The referent group represents household members with confirmed food-at-home or food-away-from-home events for a given fielding day; the overall design-based degree of freedom for variance estimation is 14,013. DSI, days since issuance of SNAP benefits; NA, not applicable; SNAP, Supplemental Nutrition Assistance Program.
[2] Unweighted number of person-days: 98,015 total.
[3] ORs from a multinomial logistic regression model estimated with respect to complex survey design features and sampling weights.
[4] *P* values were based on Wald *F*-statistics. For example, the Wald *F* test for start date had this form: $F(12, 14{,}002) = 4.62$; $P = 0.0000$.
[5] BMI is calculated as weight divided by height squared (kg/m^2). BMI categories were assigned differently for adults and children. Categories for adults were defined as not overweight (BMI <25), overweight (25 ≤ BMI < 30), and obese (BMI ≥30). For children, categories were determined by ranges of BMI percentiles as described by the CDC: not overweight (<85th percentile), overweight (≥85th–<95th percentile), and obese (≥95th percentile).
[6] Time gap: number of days between the first interview and the start date of the survey.

could not be said for predicting refusal. We noted that the Friday cohort (and to a lesser extent the Sunday cohort) showed a significant increase in the predicted marginal probability of reporting a refusal as the fielding day progressed. In contrast, the other cohorts had similar probabilities of reporting refusals over the fielding period.

Two other covariates representing paradata were found to be significant in predicting a status of refusal or unconfirmed compared with a CS. With each additional inbound call made, the odds of reporting a refusal or unconfirmed status compared with a CS were reduced. However, with each outbound call made, there was an increase in the odds of reporting a refusal or unconfirmed status than a CS.

Consistent with our hypothesis, PRs who reported household member participation with the diary survey to be very difficult or difficult, neither easy nor difficult, or had missing or not applicable data had significantly greater odds of reporting a refusal over a CS than did those PRs who found it very easy or easy. Similarly, PRs who reported participation to be very difficult or difficult or neither easy nor difficult had greater odds of an unconfirmed report than a CS when compared with those who found it very easy or easy.

The PR's ability to keep track of foods was also significantly associated with the probability of reporting a refusal compared with a CS. Surprisingly, when compared with the reference group of very easy or easy for keeping track of foods, the odds of the PR reporting a refusal over a CS were reduced by a factor of 0.39 (95% CI: 0.24, 0.64) when the PR found HR participation to be very difficult or difficult, 0.61 (95% CI: 0.43, 0.86) when the PR found it to be neither easy nor difficult, or 0.09 (95% CI: 0.03, 0.25) when the PR did not provide an answer. We elaborate on these surprising findings in the Discussion.

Members of households with SNAP participants but who had missing data on DSI had greater odds of refusing instead of having a CS than those participants residing in non-SNAP households. Members of households who had received an issuance in the last 0–10 d had greater odds of being unconfirmed than did members of non-SNAP households.

We also highlight a few notable sociodemographic predictors of participation. Younger household members were less likely to refuse, as were married household members. African Americans had greater odds of refusing, whereas members who reported multiple races had lower odds. Compared with white participants, all other racial groups had higher odds of unconfirmed reports. Finally, compared with the PR, all other HRs had higher odds of refusing or having unconfirmed reports.

Models 2 and 3: predicting FAH and FAFH events

Table 3 presents estimates from the logistic regression models predicting the reporting of FAH and FAFH events (our second research question).

FAH. Given the (nonsignificant) interaction terms, the estimated OR for fielding day (OR: 0.94; 95% CI: 0.90, 0.98) indicates that household members who started on Friday had 6% lower odds of reporting an FAH event with each additional fielding day, and this negative relation did not change significantly for any other starting dates (see **Supplemental Figure 4**, **Supplemental Table 4**). Members of households who last received a SNAP issuance either 0–10 d or 11–20 d ago had greater odds of reporting an FAH event than did members belonging to non-SNAP households. Members belonging to a household in which the PR reported that they were able to pay their bills without much difficulty or who found it occasionally difficult had higher odds of reporting an FAH event than members in households who were very comfortable and secure with their finances.

With regard to sociodemographic predictors, males, African Americans, people of other races, younger household members, and household members who were not the PRs all had lower odds of reporting an FAH event. Higher levels of education and currently being married were also associated with greater odds of reporting an FAH event.

FAFH. We found that for the Monday, Tuesday, Wednesday, and Thursday start-date cohorts, the predicted probabilities of reporting ≥1 FAFH event decreased significantly over the fielding period. The other 3 cohorts had similar probabilities of reporting FAFH events over the entire fielding period (see **Supplemental Figure 5**, **Supplemental Table 5**). Household members belonging to households that did not complete the meals and snacks form every day had lower odds of reporting an FAFH event than households that completed the form every day. Members of a household in which the PR reported that the ease of keeping track of foods was very difficult or difficult or neither easy nor difficult had greater odds of reporting an FAFH event than did members in households who found it very easy or easy to keep track of foods. Members of SNAP households, regardless of time since issuance, had lower odds of reporting an FAFH event than members belonging to non-SNAP households. In contrast, members of SNAP households with missing issuance data had greater odds of reporting an FAFH event.

With regard to sociodemographic predictors, household members who were male, obese, or aged 11–55 y (compared with the reference group of ≥55 y) or had higher levels of education all had greater odds of reporting an FAFH event. Similar to the reporting of FAH events, all non-PR household members and household members aged 0–10 y had lower odds of reporting an FAFH event.

Model 4: PR feedback on the survey process

Table 4 presents estimates from the ordinal logistic regression model (model 4) predicting the PR's feedback on ease of getting HRs to participate (our third research question). In Table 4, we note that male PRs had higher odds of finding it difficult to gain cooperation than did female PRs. If the PR completed the final interview in a language other than English, they had greater odds of experiencing difficulty in gaining the cooperation of their household than a PR who completed the final interview in English. Several household-level covariates also were found to be significant predictors in our feedback model. PRs belonging to a household that received a SNAP issuance in the previous 0–10 d had lower odds of experiencing difficulty in gaining the cooperation of their household than those PRs who belonged to non-SNAP households. PRs who reported that it was occasionally difficult to make ends meet, tough to make ends meet, or were in "over their heads" had greater odds of finding it difficult to gain household member participation than did households that were financially very comfortable and secure (see **Supplemental Figure 6**, **Supplemental Table 6**). As household size increased, the PRs' perceived difficulty to get other HRs to participate also increased significantly (see **Supplemental Figure 7**, **Supplemental Table 7**). The number of meals a household eats together also was found to be a significant predictor of cooperation difficulty. For every 1-unit increase, the odds that the PR found it difficult to gain member cooperation were reduced by 5% (OR: 0.95; 95% CI: 0.93, 0.97). Finally, PRs belonging to households in which guests came for a meal or a snack had 1.30 (95% CI: 1.04, 1.61) times higher odds of reporting a more difficult experience.

TABLE 3 Results from the multivariate logistic regression models for the association between reporting either a food-at-home or food-away-from-home event and household or household member characteristics[1]

	Food at home			Food away from home		
Predictor variable	n[2]	OR (95% CI)[3]	P[4]	n[2]	OR (95% CI)[3]	P[4]
Fielding day (centered)	85,021	0.94 (0.90, 0.98)		85,117	0.99 (0.96, 1.02)	
Start date			0.53			<0.0001
Sunday	9704	0.91 (0.70, 1.19)		9734	1.05 (0.83, 1.31)	
Monday	6628	0.89 (0.67, 1.17)		6628	2.06 (1.56, 2.73)	
Tuesday	14,789	0.96 (0.76, 1.22)		14,810	1.61 (1.30, 1.99)	
Wednesday	14,431	0.89 (0.71, 1.12)		14,445	1.45 (1.19, 1.76)	
Thursday	13,685	0.81 (0.66, 1.00)		13,696	1.43 (1.17, 1.76)	
Saturday	11,565	0.98 (0.78, 1.24)		11,571	0.88 (0.70, 1.10)	
Friday (referent)	—	—		—	—	
Start date × fielding day (centered)			0.27			<0.0001
Sunday	9704	1.00 (0.93, 1.08)		9734	1.02 (0.97, 1.07)	
Monday	6628	0.98 (0.91, 1.06)		6628	0.84 (0.79, 0.90)	
Tuesday	14,789	0.97 (0.90, 1.04)		14,810	0.89 (0.84, 0.93)	
Wednesday	14,431	1.00 (0.94, 1.06)		14,445	0.92 (0.88, 0.97)	
Thursday	13,685	1.01 (0.95, 1.07)		13,696	0.95 (0.91, 0.99)	
Saturday	11,565	0.93 (0.87, 1.00)		11,571	1.03 (0.97, 1.09)	
Friday (referent)	—	—		—	—	
BMI[5]			0.47			0.0197
Overweight (25.0–29.9)	22,454	0.98 (0.89, 1.09)		22,484	1.09 (0.96, 1.23)	
Obese (≥30.0)	24,971	0.93 (0.84, 1.03)		24,975	1.18 (1.05, 1.32)	
NA or missing or error	5357	1.03 (0.68, 1.57)		5371	0.80 (0.55, 1.18)	
Not overweight (<24.9) (referent)	—	—		—	—	
Sex						
Male	39,442	0.80 (0.72, 0.89)		39,490	1.23 (1.11, 1.37)	
Female (referent)						
Age category			<0.0001			<0.0001
0–10 y	16,804	0.00 (0.00, 0.01)		16,900	0.35 (0.26, 0.49)	
11–15 y	7130	0.05 (0.03, 0.11)		7130	1.87 (1.38, 2.53)	
16–20 y	6326	0.32 (0.23, 0.45)		6326	1.72 (1.36, 2.18)	
21–30 y	12,805	0.70 (0.61, 0.81)		12,805	1.75 (1.48, 2.06)	
31–55 y	26,726	0.94 (0.84, 1.05)		26,726	1.46 (1.28, 1.67)	
>55 y (referent)	—	—		—	—	
Income (adjusted)		1.00 (1.00, 1.00)		85,117	1.00 (1.00, 1.00)	
Education			0.0006			0.0013
High school graduate but no college	29,895	1.14 (1.02, 1.28)		29,909	1.20 (1.03, 1.40)	
College graduate and above	17,761	1.29 (1.13, 1.47)		17,836	1.38 (1.16, 1.64)	
Below high school (referent)	—	—		—	—	
Marital status			0.0424			0.59
Married	26,961	1.16 (1.00, 1.33)		27,020	0.90 (0.78, 1.03)	
Widowed	3166	1.01 (0.83, 1.23)		3166	0.86 (0.68, 1.09)	
Divorced	8031	0.95 (0.81, 1.12)		8031	0.92 (0.76, 1.10)	
Separated	2085	1.03 (0.80, 1.33)		2092	0.97 (0.64, 1.47)	
Never married (referent)	—	—		—	—	
Race			0.0015			0.58
Black/African American	12,270	0.85 (0.75, 0.97)		12,277	0.96 (0.84, 1.09)	
Other race	12,213	1.16 (1.03, 1.31)		12,249	0.92 (0.81, 1.05)	
Multiple races	2187	1.11 (0.87, 1.41)		2187	1.04 (0.76, 1.42)	
White (referent)	—	—		—	—	
Relationship to primary respondent			<0.0001			<0.0001
Partner or children	43,938	0.19 (0.16, 0.22)		43,972	0.44 (0.39, 0.50)	
Other relatives	8047	0.19 (0.15, 0.25)		8054	0.40 (0.33, 0.49)	
Nonrelatives	2118	0.23 (0.17, 0.32)		2132	0.38 (0.27, 0.53)	
Primary respondent (referent)	—	—		—	—	
Time gap[6]	85,021	0.99 (0.96, 1.02)		85,117	0.99 (0.96, 1.03)	
Meals and snacks forms completed			0.45			0.0136
<1, not every day	15,256	0.96 (0.87, 1.06)		15,285	0.82 (0.73, 0.92)	

(Continued)

TABLE 3 *Continued*

Predictor variable	Food at home			Food away from home		
	n^2	OR (95% CI)[3]	P^4	n^2	OR (95% CI)[3]	P^4
Once before end	1300	1.34 (0.98, 1.82)		1300	0.73 (0.52, 1.03)	
Once at end	2853	0.99 (0.79, 1.23)		2860	1.02 (0.80, 1.31)	
Did not complete	2628	1.06 (0.85, 1.33)		2628	0.91 (0.69, 1.19)	
Missing	2950	0.96 (0.71, 1.30)		2964	0.93 (0.57, 1.50)	
Every day (referent)	—	—		—	—	
Member participation			0.38			<0.0001
Very difficult/difficult	13,492	1.11 (0.96, 1.30)		13,532	1.23 (1.04, 1.46)	
Neither easy nor difficult	7107	1.04 (0.91, 1.20)		7114	1.19 (1.03, 1.37)	
NA/missing	6440	1.10 (0.95, 1.27)		6461	0.73 (0.61, 0.88)	
Very easy/easy (referent)	—	—		—	—	
Ease of keeping track of foods			0.18			0.0001
Very difficult/difficult	12,097	1.00 (0.68, 1.45)		12,110	1.36 (1.13, 1.63)	
Neither easy nor difficult	5062	1.07 (0.86, 1.32)		5078	1.39 (1.18, 1.62)	
Missing	2339	1.18 (1.02, 1.37)		2353	1.22 (0.69, 2.13)	
Very easy/easy (referent)	—	—		—	—	
SNAP categories			<0.0001			<0.0001
0–10 DSI SNAP household	12,503	1.34 (1.17, 1.54)		12,505	0.51 (0.43, 0.60)	
11–20 DSI SNAP household	10,180	1.37 (1.16, 1.63)		10,185	0.58 (0.50, 0.68)	
21–31 DSI SNAP household	8437	0.99 (0.86, 1.15)		8437	0.66 (0.56, 0.77)	
SNAP household but DSI missing	387	1.37 (0.70, 2.66)		387	2.21 (1.32, 3.71)	
Non-SNAP household (referent)	—	—		—	—	
Financial condition			0.23			0.10
Without much difficulty	23,592	1.13 (1.00, 1.28)		23,592	1.06 (0.93, 1.21)	
Occasionally difficult	26,629	1.16 (1.02, 1.33)		26,690	1.01 (0.87, 1.17)	
Tough to make ends meet	19,485	1.14 (0.98, 1.34)		19,506	0.92 (0.78, 1.09)	
In over your head	5235	1.16 (0.95, 1.42)		5235	0.82 (0.66, 1.02)	
Very comfortable and secure (referent)	—	—		—	—	
Bill review			0.16			0.28
Rarely	5643	1.19 (0.95, 1.48)		5643	1.06 (0.82, 1.36)	
Sometimes	14,112	1.28 (1.07, 1.53)		14,128	0.89 (0.73, 1.10)	
Usually	13,645	1.15 (0.96, 1.38)		13,659	0.90 (0.73, 1.11)	
Always	42,415	1.16 (0.99, 1.35)		42,481	0.96 (0.80, 1.16)	
NA	588	0.95 (0.52, 1.74)		588	0.60 (0.33, 1.10)	
Never (referent)	—	—		—	—	
Pay bills on time			0.60			0.05
Rarely	2780	0.77 (0.49, 1.22)		2780	1.17 (0.81, 1.69)	
Sometimes	12,495	0.76 (0.50, 1.16)		12,495	1.09 (0.79, 1.49)	
Usually	22,906	0.73 (0.48, 1.11)		22,942	1.14 (0.84, 1.56)	
Always	45,037	0.75 (0.49, 1.14)		45,097	0.95 (0.70, 1.29)	
Don't know/refused	317	0.47 (0.19, 1.14)		317	0.87 (0.36, 2.09)	
Never (referent)	—	—		—	—	
Household size	85,021	1.03 (1.00, 1.06)		85,117	0.97 (0.94, 1.00)	
Inbound calls	85,021	1.03 (0.99, 1.06)		85,117	1.03 (1.00, 1.07)	
Outbound calls	85,021	1.01 (0.98, 1.03)		85,117	1.02 (0.99, 1.06)	

[1] The referent group represents household members not reporting either a food-at-home or food-away-from-home event for a given fielding day, respectively; the overall design-based degree of freedom for variance estimation for the food-at-home model is 13,296 and for the food-away-from-home model is 13,311. DSI, days since issuance of SNAP benefits; NA, not applicable; SNAP, Supplemental Nutrition Assistance Program.
[2] Unweighted number of person-days: 85,021 total.
[3] ORs from a logistic regression model estimated with respect to complex survey design features and sampling weights.
[4] *P* values were based on Wald *F*-statistics.
[5] BMI is calculated as weight divided by height squared (kg/m^2). BMI categories were assigned differently for adults and children. Categories for adults were defined as not overweight (BMI <25), overweight (25 ≤ BMI < 30), and obese (BMI ≥30). For children, categories were determined by ranges of BMI percentiles as described by the CDC: not overweight (<85th percentile), overweight (≥85th–<95th percentile), and obese (≥95th percentile).
[6] Time gap: number of days between the first interview and the start date of the survey.

Discussion

Predictors of reporting status. The increases in the probability of nonresponse as a function of fielding day were perhaps due to increased fatigue and reduced motivation in later days of the fielding period. This suggests that aggregation of food acquisition data in these types of diary surveys (without accounting for the differences in response rates and respondent characteristics

TABLE 4 Results from the ordinal logistic regression model for the association between the ease of gaining household member cooperation and household or primary respondent characteristics[1]

Predictor variable	n^2	OR (95% CI)[3]	P^4
Sex			
Male	793	1.69 (1.27, 2.24)	
Female (referent)	—	—	
Age	3557	1.01 (1.00, 1.02)	
Education			0.21
High school	1758	0.78 (0.58, 1.07)	
College	1175	0.87 (0.63, 1.20)	
Below high school (referent)	—	—	
Race			0.31
Black/African American	497	0.74 (0.46, 1.20)	
Other race	519	1.11 (0.84, 1.46)	
Multiple races	65	0.76 (0.34, 1.68)	
White (referent)	—	—	
SNAP categories			0.0117
0–10 DSI SNAP household	496	0.63 (0.44, 0.91)	
11–20 DSI SNAP household	356	0.79 (0.57, 1.08)	
21–31 DSI SNAP household	362	0.82 (0.53, 1.26)	
SNAP household but DSI missing	16	1.72 (0.95, 3.12)	
Non-SNAP household (referent)	—	—	
Any member eligible for WIC			
Yes	2596	0.76 (0.55, 1.05)	
No (referent)	—	—	
Financial condition			0.0017
Without much difficulty	1012	1.07 (0.81, 1.41)	
Occasionally difficult	1088	1.67 (1.14, 2.44)	
Tough to make ends meet	789	1.58 (1.12, 2.23)	
In over your head	203	2.63 (1.62, 4.28)	
Very comfortable and secure (referent)	—	—	
Final interview language			
Non-English	321	1.69 (1.01, 2.82)	
English (referent)	—	—	
Household in rural area			
Yes	989	0.91 (0.72, 1.15)	
No (referent)	—	—	
Household size	3577	1.22 (1.14, 1.31)	
Owns, rents or does not pay for residential unit			0.45
Rent	1780	0.93 (0.74, 1.15)	
Other, do not pay for housing	98	1.23 (0.74, 2.07)	
Own (referent)	—	—	
Number of meals together	3577	0.95 (0.93, 0.97)	
Any guest coming for meal or snack			
Yes	1065	1.30 (1.04, 1.61)	
No (referent)	—	—	

[1] The primary respondent reported difficulty: 1 = very easy to 5 = very difficult (referent group); the overall design-based degree of freedom for variance estimation is 55. DSI, days since issuance of SNAP benefits; NA, not applicable; SNAP, Supplemental Nutrition Assistance Program; WIC, Special Supplemental Nutrition Program for Women, Infants, and Children.

[2] Unweighted number of households with 2-person minimum: 3557 total.

[3] ORs from an ordinal logistic regression model estimated with respect to complex survey design features and sampling weights. ORs >1 indicate greater difficulty.

[4] *P* values were based on Wald *F*-statistics.

across fielding days) could mask the 7-d trajectories in key survey outcomes and bias the estimates. To our knowledge, this is the first study to show such a phenomenon and raises concerns about these possible errors. Our results related to calling behavior and completion of the snack and meal forms revealed that PR and HR general cooperation levels play an important role in reducing nonresponse. Results related to the financial management variables also support our hypothesis that those who have difficulty managing their money are more likely to provide unconfirmed reports (i.e., no food acquisitions were reported, but the PR could not confirm this). The surprising evidence of decreases in the probability of nonresponse for the PRs who found it difficult to keep track of food for themselves could be due to these PRs exerting more effort than others, leading them to feel that the diary process was more difficult. The association between larger household size and increased probability of nonresponse may be due to the increased difficulty of keeping track of every member's food acquisitions in large households. The missing DSI information for SNAP households generally occurred when PRs erroneously reported that no household member was participating in SNAP. The evidence that such households also were less cooperative with survey participation may indicate a general lack of commitment to the survey or a less-cohesive family structure in which the PR was unable to gain the full cooperation of all HRs.

Predictors of FAH and FAFH event reporting. We found that respondents were less likely to report FAH events in later fielding days, which may suggest underreporting. However, we could not rule out the possibility of a Hawthorne effect (19, 20)—that the survey itself may change respondents' behavior so that they are more likely to engage in an FAH event early in the fielding period, right after the survey is introduced to them. On the other hand, because FAFH purchases are more of a daily event than FAH (e.g., grocery shopping), we can reasonably assume that the occurrence of FAFH events might be less affected by the data collection process and that the decline in the probability of reporting FAFH events over the fielding period probably indicates a concurrent increase in underreporting. The evidence that male and younger respondents were more likely to report FAFH events but not FAH events may be due to their actual food acquisition behaviors. Results related to other variables may imply potential reporting errors. For example, compared with PRs, HRs are less likely to report FAFH events, which may indicate general underreporting for HRs, given that one could reasonably expect that PRs and HRs have similar FAFH acquisitions, on average. Similarly, those who complete the meals and snack forms less often are less likely to report FAFH events, which may also indicate underreporting among these individuals. The observation that SNAP households are less likely to report FAFH events but not FAH events is consistent with previous research (21) and not surprising, given that participants cannot use their SNAP benefits for FAFH. Although these results do not allow us to distinguish actual food acquisition behaviors and reporting error (given that we do not have actual measures of food acquisitions), they suggest that all of these features need to be carefully accounted for when studying such food acquisition events.

Predictors of PR feedback. The lower reported difficulty with getting HRs to cooperate among female PRs might be due to the fact that female PRs have more interactions with HRs in terms of food acquisition [e.g., female are responsible for more grocery shopping (22) and do more food-related work (23)], which allows them to easily track HRs' food acquisitions. As expected, more complicated household structures and dining dynamics (e.g., a large household and those who have guests coming for meals) and more independent dining behavior (e.g., PRs who eat meals with HRs less often) added to the difficulty of keeping track of HRs' food acquisitions.

Recommendations for the design of future food acquisition surveys. This study has important implications for future designs of food acquisition surveys. First, given that the Friday and Sunday start-date cohorts had the highest probability of nonresponse (refusal and being unconfirmed, respectively) and the largest increases in nonresponse rates as the fielding days progressed, future food acquisition surveys might avoid starting interviews on Friday and Sunday or implementing more follow-up activities for these 2 cohorts. Although these findings clearly need to be replicated in other studies, the results for Friday and Sunday could be due to the fact that these 2 d are generally transition dates between work and rest. On these transition days, respondents may not be as engaged as on other days, essentially "getting off on the wrong foot" (FoodAPS did not collect direct information on work days for each individual). Second, to reduce respondents' burdens and secure more cooperation among the household members, alternative design strategies could be used, such as preloading the household member information in the diary book or using mobile phone or tablet diaries. Pilot testing of a diary approach with the use of the Internet or mobile phones is underway, and although this approach seems attractive (e.g., real-time data collection, respondent convenience, interactive and tailored design features), much more work is needed to examine the quality of the responses provided, and, to our knowledge, no literature has addressed this yet in this specific context.

With regard to reducing the difficulty of getting other household members to participate, future food acquisition surveys may consider choosing female PRs rather than male PRs. In addition, survey participation could be increased by following the principles of responsive survey design (24). Specifically, auxiliary information, including paradata representing feedback from households that have completed the survey on the ease of the survey process, could be used to identify households at greater risk of experiencing difficulty and thus potentially providing poor-quality data. For example, in the screening interview, an effort could be made to collect the following variables, which were found to be predictive of a PR's reported difficulty with getting HRs to participate: the household's financial condition, the frequency that households have guests coming over for meals, and how often PRs eat meals together with other HRs. Interventions could then be tailored to those identified households during data collection to minimize survey errors. For example, to help PRs who are predicted to have higher difficulty getting other household members to cooperate (e.g., larger households and households "in over their heads" financially), tailored interventions (e.g., increased incentives, modified introductions to address their unique circumstances and/or food books with preloaded instructions) could be provided to these households once the relevant household member's information (e.g., household size) is collected at the screening or initial interviews.

We note that, in general, future surveys could minimize variation in data collection procedures to the greatest extent possible and, following responsive survey design ideas, these interventions would only be applied to households predicted to have difficulty. We also note that there is an important trade-off between survey data quality and survey costs, which needs to be taken into careful consideration when designing surveys and planning interventions. Provided that the costs of implementing them do not become excessive, these aforementioned interventions can be considered in an effort to obtain higher-quality data in future food acquisition surveys.

Directions for future research. Our study identified 4 important directions for future research. First, future studies could attempt to replicate our work and use paradata to further evaluate various error sources related to food acquisition surveys. We suggest that future studies could also apply our approach to diet diary surveys (which are more widely used but were outside the scope of the present investigation) to determine whether similar errors may appear in diet diary surveys as well. Second, subject to institutional review board approval, future studies could explore the use of other types of paradata in survey error evaluations. For example, several studies have used the passive collection of Geographic Information Systems (GIS) data to address research questions (25–28), and future surveys such as FoodAPS could use GIS data to validate whether underreporting occurs (e.g., the GIS data could show that members went to a restaurant and stayed for 1.5 h but did not report FAFH events). Furthermore, interview recording data (e.g., audio recordings of the screening interviews) could be used to better understand reasons for nonresponse. Third, future studies can also explore other factors that can influence food acquisition survey data quality, including interviewer effects (i.e., the degree to which the presence of interviewers can influence survey responses) on survey responses. Finally, given the findings of this study, future studies could evaluate whether food acquisition surveys focusing on shorter periods of data collection can remedy the survey error issues related with the current diary survey design. For example, 2 nonconsecutive 3-d diary periods spaced 1 wk apart could be used to reduce fatigue, and potentially reduce nonresponse and underreporting.

In conclusion, our study indicates that both survey response and reporting of food acquisition events decreased across a 7-d reporting and diary period in the first FoodAPS. Future implementations of this or other food acquisition surveys can use the findings of this study to introduce efficiencies in the design of these future surveys.

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MH, GWG, JAK, and BTW designed and conducted the research; MH and GWG analyzed the data and wrote the manuscript; and MH had primary responsibility for the final content. All authors read and approved the final manuscript.

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