Nutritional profile of Supplemental Nutrition Assistance Program household food and beverage purchases[1,2]

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ABSTRACT

Background: The Supplemental Nutrition Assistance Program (SNAP), which is the largest federal nutrition assistance program in the United States, serves nearly 1 of 7 Americans. To date, few studies have examined food and beverage purchase behaviors in SNAP participants with the use of electronic purchase data.

Objective: In this cross-sectional study, we examined household store purchases of key food, beverage, and nutrient groups in SNAP participants and nonparticipants.

Design: Using a data set of US households' (n = 98,256 household-by-quarter observations) packaged food and beverage purchases and SNAP status [current participant, income-eligible nonparticipant (income ≤130% of the Federal Poverty Level [FPL]), and higher-income nonparticipants (income >130% of the FPL)] from 3 quarters during 2012–2013, we estimated pooled ordinary least-squares models, clustered at the household level, to examine the association between SNAP status and purchases while controlling for sociodemographic characteristics. We examined purchases of health- and policy-relevant food and beverage groups [e.g., fruit and sugar-sweetened beverages (SSBs)] and nutrients (e.g., total calories and sodium).

Results: Regardless of SNAP status, households had low mean purchases of fruit, vegetables, and fiber and high mean purchases of junk foods, saturated fat, and sodium. After adjustment for multiple comparisons and demographic characteristics, we found significant differences by SNAP status of purchases of fruit, processed meat, salty snacks, sweeteners and toppings, SSBs, and total calories, fiber, sugar, and sodium. Several of these differences were clinically important. For example, compared with income-eligible and higher-income nonparticipants, SNAP participants purchased an additional ∼15–20 kcal · person^{-1} · d^{-1} from SSBs ($P < 0.0001$) and ∼174–195 mg total Na · person^{-1} · d^{-1} ($P < 0.0001$). Results were robust to corrections for sample-selection bias and to the exclusion of observations with potentially misreported SNAP status.

Conclusions: American households, including SNAP households, show room for improvement in the nutritional quality of store purchases. New interventions and policies may be needed to improve food and beverage purchases in both SNAP and non-SNAP households. *Am J Clin Nutr* 2017;105:1433–42.

Keywords: big data, diet quality, food and beverage purchases, food-purchase data, health disparities, income disparities, low income, nutrients, Supplemental Nutrition Assistance Program

INTRODUCTION

The Supplemental Nutrition Assistance Program (SNAP)[6] is the largest nutrition assistance program in the United States and served >44 million people in 2016 or ∼1 of 7 Americans (1). One of SNAP's primary aims is to improve the dietary quality of low-income Americans (2). This goal is particularly important because of the high rates of obesity, diabetes, and other diet-related diseases in the low-income populations that SNAP serves (3–6). Accordingly, researchers and policymakers have shown considerable interest in the diets of SNAP participants.

Several studies have described the diet-related behaviors of SNAP participants (6–10). To date, nearly all of this research has used self-report measures of dietary intake (11). Household food-purchase data, which are generated when participants scan the barcodes of the products that they have purchased and brought home, can provide a useful complement to self-reported dietary intake data. Although these data have some important limitations (e.g., they often do not capture food that is purchased and consumed away from home [food away from home (FAFH)] or items that do not have barcodes such as bulk produce), they are particularly useful for studying SNAP households because they contain information on purchases that can be purchased with SNAP benefits (i.e., foods and beverages that are purchased in stores for consumption at home). Purchase data also offer some advantages over self-reported dietary intake data including that the data collection does not rely on participants' memories, thereby potentially reducing misreporting (12, 13); and many

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[2] Supplemental Figure 1, Supplemental Tables 1–4, and Supplemental Information are available from the "Online Supporting Material" link in the online posting of the article and from the same link in the online table of contents at http://ajcn.nutrition.org.

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[6] Abbreviations used: FAFH, food away from home; FoodAPS, National Household Food Acquisition and Purchase Survey; FPL, Federal Poverty Level; IPW, inverse probability weight; SNAP, Supplemental Nutrition Assistance Program; SSB, sugar-sweetened beverage; UPC, Universal Product Code.

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purchase data sets follow participants over months or years, and thus reflect usual, long-term habits.

Despite the potential benefits, only a limited number of studies have leveraged electronic purchase data to examine food and beverage purchases in SNAP households (14–17), and no study, to our knowledge, has used these data to describe SNAP-household purchases across multiple food, beverage, and nutrient groups. The estimation of the current purchases of SNAP households can help identify specific dietary areas to target in future interventions. In addition, policymakers and researchers have proposed a number of reforms to the SNAP benefits package, including calls to provide incentives for purchasing fruit and vegetables (18–20) and to end subsidies for candy (21), junk foods (21, 22), and sugar-sweetened beverages (SSBs) (2, 22–25). Estimates of current purchases of policy-relevant items are needed to define the potential for these policies to meaningfully change the overall nutritional quality of SNAP household purchases.

The aim of this study was to describe the usual purchases of SNAP households across key food, beverage, and nutrient groups, including policy-relevant categories, by using a large data set of US households' store purchases. To provide a point of reference, we also estimated purchases in income-eligible and higher-income non-SNAP households. Because of the nature of the data, we did not seek to establish causal impacts of SNAP and we could not comment on household purchases of items without barcodes (e.g., food from restaurants, work, or school or loose produce).

METHODS

Data

Data for this study came from the Nielsen Homescan Panel (The Nielsen Co.). The Homescan Panel is an ongoing longitudinal data set that contains product-level information on food and beverage purchases from a sample of ~60,000 households across 76 US markets. Details on the Homescan Panel have been shown elsewhere (26). Briefly, participants used digital scanners to record the Universal Product Code (UPC) of all packaged foods and beverages that they purchased from stores and brought into the home. Data on each product included the volume, price, and retailer. Items without UPC codes, including random-weight items such as loose produce, bulk grains, and fresh meat and seafood, were not captured. Although this exclusion suggests that approximations of total purchases of categories such as fruit and vegetables are likely to be underestimated, random-weight purchases of fruit and vegetables account for only ~5% of total expenditures. In addition, research that has used similar data sets has suggested that the exclusion of random-weight purchases has a very small effect on estimates of fruit and vegetable purchases (27), and previous work with Homescan data has shown that the ratio of purchases of nonpackaged to packaged fruit and vegetables is similar across most income groups (28). In addition, we focused only on household store purchases because Homescan data do not include information on foods and beverages that are purchased and consumed away from home (e.g., in a restaurant, at school, or at work). Purchases are linked at the UPC level to detailed nutrition information with the use of Nutrition Facts Panel data (29). Homescan data also provides information on the social and demographic characteristics of households (e.g., household composition and income) and geography (e.g., market).

Sample population

This study used Homescan data from 3 quarters (the fourth quarter of 2012 and the second and fourth quarters of 2013) for which SNAP participation data were available (n = 182,492 household-by-quarter observations). We excluded 4293 observations because they did not meet the consistent reporting requirements for food purchases (i.e., the household recorded <$135 of food items purchased in the previous 4-wk period for households with ≥2 members or <$45 for households with one member), and an additional 141 observations were excluded because per-capita purchases could not be computed because of censoring of the household-size variable (households with ≥9 members) (**Supplemental Figure 1**). These exclusions yielded 178,058 household-by-quarter observations from 70,447 unique households (mean follow-up for the sample: 2.53 quarters; range: 1–3 quarters). Purchases across food, beverage, and nutrient groups (see Purchase outcomes section) were aggregated to the quarter-level for each household.

SNAP participation and eligibility

In accordance with previous studies (7, 9, 30), households were considered income-eligible for SNAP if their reported total household income that was ≤130% of the Federal Poverty Level (FPL), which is the gross-income cutoff for SNAP eligibility at the federal level (31). Some states allow households with incomes ≤185% of the FPL to participate in SNAP (e.g., 32), and ≥1 study has used this higher cutoff for the assessment of SNAP eligibility (33). We found no differences in the pattern of results when 185% or 130% of the FPL was used as our SNAP eligibility cutoff (results not shown), and we used the federal cutoff of 130% of the FPL to maximize the comparability of our study with the previous literature (7, 9, 30). Households with incomes >130% of the FPL were classified as households with higher income. Homescan participants also provided information on their household's participation in SNAP by responding to a the following single item: "Are you or anyone in your household currently using or have you ever used food stamps, which includes food stamp card or voucher or cash grant from the state for food [also known as Supplemental Nutritional Assistance Program (SNAP), Electronic Debit Card (EBT card)]?" Participants could indicate whether they were current, past, or never participants. Of 178,058 household-by-quarter observations that met the reporting requirements and had a household size ≤8 members, 55.18% of observations (n = 98,256) provided a response to the item about SNAP participation and were included in the analytic sample; observations without SNAP data were excluded (Supplemental Figure 1). We classified households as current participants if they indicated that they were currently participating in SNAP or as nonparticipants if they indicated that they were past or never participants. To qualitatively assess the extent to which the sample represented the broader populations of SNAP participants, eligible nonparticipants, and higher income nonparticipants, we examined the demographic characteristics of these groups in the Homescan sample side by side with demographic characteristics of the same groups in a nationally representative sample from the National

Household Food Acquisition and Purchase Survey (FoodAPS) (**Supplemental Table 1**).

Observations without data on SNAP participation because of nonresponse (n = 79,802; 44.8% of the sample) were excluded from the main analyses. To examine factors that predicted the selection in the analytic sample (i.e., the factors that were associated with having nonmissing SNAP data), we estimated a logistic regression of having nonmissing SNAP status (yes compared with no) on sociodemographic characteristics (**Supplemental Information**, **Supplemental Table 2**). We used these regression results to estimate each household's predicted probability of having a nonmissing SNAP status during each quarter and calculated a time-varying inverse probability weight (IPW) by taking the inverse of this predicted probability. As discussed in the Statistical analysis section, weighting observations by these IPWs helped to account for the selection of households in our analytic sample.

Purchase outcomes

Our outcomes of interest included store purchases of key food and beverage groups (e.g., fruit, vegetables, processed meats, junk foods, SSBs, and milk) (**Supplemental Table 3**), which were expressed as kcal · person^{-1} · d^{-1} (or, for alcohol, as kcal · adult^{-1} · d^{-1}). The Homescan data set groups each product into a module, which are small sets of similar products (e.g., some representative modules include canned pears, olive oils, mozzarella cheese, and frozen broccoli) that are grouped on the basis of consumer purchase behaviors (i.e., where a consumer would typically find an item in a grocery store). We used the Homescan module descriptions to group items into food and beverage groups. For example, the fruit category included all Homescan modules for fresh, frozen, canned, and dried fruit. To transform purchases from quarter-level totals into units of per person per day, we divided total purchases for each quarter by the number of days in the quarter (91 d for the fourth quarters of 2012 and 2013 and 92 d for the second quarter of 2013) and again by the number of individuals in the household (or, for alcohol, the number of adults in the household). Food and beverage groups were selected to include those that have been consistently linked to health outcomes or targeted by recent proposals to reform SNAP. For example, we included several fruit and vegetables categories because the consumption of fruit and vegetables is associated with reduced risk of coronary heart disease and stroke (34–36) and was the focus of the SNAP Healthy Incentives Pilot (18). Likewise, we included SSBs because the consumption of these beverages has been linked to increased risk of both obesity and diabetes (37–40), and SSBs are frequently targeted by SNAP reform proposals (2, 21, 23, 24) (details on how we categorized items as well as the justifications for each category that we examined are shown in Supplemental Table 3). In addition to food and beverage groups, we also examined total store purchases of key nutrients (kilocalories, sodium, saturated fat, sugars, and fiber) and again transformed these in units of per person per day. For estimates of total sodium, we excluded purchases of baking soda because baking soda is frequently used for cleaning and deodorizing.

Demographic variables

Demographic variables included household composition [household size, presence of any children, number of children, presence of children in specific age groups (<2, 2–5, 6–11, and 12–18 y old), and marital status], age of the household head (man or woman, whomever was older), race/ethnicity of the household head (non-Hispanic white, Hispanic, non-Hispanic black, and non-Hispanic other), maximum educational attainment in the household (collapsed from 6 to 4 categories as follows: high school or less, some college, college graduate, and postcollege degree), and income as the percentage of the FPL.

Statistical analysis

Household-by-quarter observations were pooled, and SEs were clustered at the household-level to account for repeated observations. We estimated unadjusted means and proportions for demographic characteristics across the following 3 subgroups: SNAP participants, income-eligible nonparticipants, and higher-income nonparticipants. We tested for differences in demographic characteristics across groups with ANOVA or chi-square tests. Next, we estimated unadjusted mean and median purchases for foods, beverages, and nutrients across the 3 groups.

To estimate differences across groups of SNAP status after accounting for differences in demographic characteristics, we used linear regression models in which food, beverage, or nutrient purchases were regressed on SNAP status while controlling for demographic characteristics (household composition, age, race/ethnicity, educational attainment, and income), number of purchases made, market indicators, and a year indicator. We explored whether the race/ethnicity of the household head moderated any associations between SNAP participation status and purchase outcomes; however, no interactions were significant after correction for multiple comparisons; thus, we report models without any interaction between SNAP participation and race/ethnicity. We report the adjusted mean difference in purchase outcomes comparing income-eligible nonparticipants and higher-income nonparticipants to the referent category (i.e., current SNAP participants). Thus, a negative mean difference indicated that (after adjustment for sociodemographic characteristics) nonparticipants purchased less of the food, beverage, or nutrient in question than did current SNAP participants, whereas a positive mean difference indicated that nonparticipants purchased more of the food, beverage, or nutrient than did SNAP participants. Adjusted mean differences were calculated by using the margins command in Stata version 14.1 software (StataCorp LP), clustering SEs at the household level to account for repeated observations. Because we examined a total of 22 outcomes (13 food groups, 4 beverage groups, and 5 nutrients), we evaluated statistical significance with the use of a Bonferroni-corrected α = 0.0023 (i.e., 0.05 divided by 22). As a sensitivity analysis to account for selection in the analytic sample, we also estimated all models with IPWs to account for the differential likelihood of reporting SNAP participation (see also Supplemental Information).

SNAP status has sometimes been misreported in surveys (41–44); thus, we also conducted sensitivity analyses with correction for potential SNAP misreporting. Although it is difficult to ascertain false negatives without administrative data, potential false positives (i.e., households that reported participating in SNAP but who may not have been true participants) were identified by examining household self-reported income. We found that 18.7% of households that reported current SNAP participation also reported income between 131% and 185% of the FPL and another 24.6% of households that reported current SNAP participation reported income >185% of the FPL. These households might have misreported their SNAP status, income,

both, or neither, but the data did not readily allow us to discern which of these scenarios was most likely. For example, if potential false-positive cases report incomes above the mean for a given level of education, we might suspect that income misreporting is more likely than is SNAP misreporting. However, exploratory analyses found a consistent pattern of income-for-educational attainment between potential false positives compared with unlikely false positives. In addition, income is reported yearly in the Homescan data, but SNAP eligibility is typically determined based on recent monthly income; thus, households with yearly incomes that were greater than the cutoff might have still experienced months in which they were eligible for SNAP, which would potentially explain some of the apparent false positives. That said, the presence of a number of households that simultaneously report incomes above the SNAP eligibility cutoff as well as current SNAP participation indicated that there may have been false positives in our sample. To examine whether results were sensitive to this potential classification error, we reran all analyses with the exclusion of potential false positives. We designated potential false positives with the use of 2 definitions as follows: first, households that reported both SNAP participation and income >130% of the FPL and, second, households that reported SNAP participation and income >185% of the FPL. The latter definition was used because some states allow for households with gross incomes ≤185% of the FPL to participate in SNAP (e.g., 32). All analyses were conducted with Stata version 14.1 software.

Ethics

This study used a secondary data set of deidentified data and was exempt from the review of an institutional review board.

RESULTS

Demographics

A total of 98,256 household-by-quarter observations had complete SNAP data and were included in the analyses. Approximately 7% of the analytic sample reported being current SNAP participants with another 6% of the sample being income-eligible nonparticipants and the remaining 87% of the sample being higher-income nonparticipants. SNAP participants, income-eligible nonparticipants, and higher-income nonparticipants differed in their demographic characteristics (**Table 1**). For example, SNAP participants were more likely than either category of nonparticipant to be non-Hispanic black (14% of current participants compared with 8% in both nonparticipant groups; $P < 0.001$). SNAP households were also headed by slightly younger adults (~55.5 y of age in SNAP-participating households compared with ~59 y of age in both groups of nonparticipants; $P < 0.001$), were less likely to have a household head who was married ($P < 0.001$), and were more likely to have any children living in the household ($P < 0.001$). In addition, SNAP participants, income-eligible nonparticipants, and higher-income nonparticipants in the sample had somewhat different characteristics than these groups did in the FoodAPS nationally representative sample (Supplemental Table 1). For example, in the Homescan Sample, SNAP households, income-eligible nonparticipating households, and higher-income nonparticipating households were slightly smaller in size, less likely to have children, and more likely to be non-Hispanic white than were peer households that participated in the FoodAPS.

Food, beverage, and nutrient purchases

In unadjusted analyses, households purchased a mean of 1400–1600 kcal · person^{-1} · d^{-1}. Most households, regardless of SNAP or income status, purchased considerable amounts of less-healthful foods and nutrients. For example, households purchased a mean of 51–89 kcal SSBs · person^{-1} · d^{-1} and 453–476 kcal junk foods · person^{-1} · d^{-1} (**Table 2**). Total sodium purchases were high at ~2400–2700 mg · person^{-1} · d^{-1}. Although store purchases cannot be directly compared with dietary guidelines (e.g., because households may purchase and consume foods from locations other than stores), mean total sodium purchases were greater than the recommended daily allowance of 1500–2300 mg in the 2015 Dietary Guidelines for Americans (45) even when not accounting for FAFH purchases. Likewise, mean store purchases of total saturated fat were ~23–27 g · person^{-1} · d^{-1} compared with a recommended daily allowance of ~22 g/d for a 2000-cal diet.

In multivariate adjusted analyses, there were both similarities and differences between SNAP participants and nonparticipants in purchases of some food groups. For several food groups, nonparticipating households purchased higher amounts of healthful foods and lower amounts of unhealthful foods than did SNAP-participating households. Income-eligible nonparticipating households purchased significantly greater calories from fruit than SNAP households did (mean difference: +4.35 kcal · person^{-1} · d^{-1}; $P < 0.0001$) as did higher-income nonparticipants (mean difference: +4.46 kcal · person^{-1} · d^{-1}; $P < 0.0001$). Income-eligible nonparticipants purchased fewer calories from processed meat (mean difference: −8.41; $P < 0.0001$) and from sweeteners and toppings (mean difference: −10.81 kcal · person^{-1} · d^{-1}; $P = 0.0001$) than did SNAP participants. Similar results were seen for higher-income nonparticipants, who purchased fewer calories from processed meats (mean difference: −8.44; $P < 0.0001$) and from sweeteners and toppings (mean difference: −11.86 kcal · person^{-1} · d^{-1}; $P < 0.0001$) than did current SNAP participants. However, the opposite pattern occurred for salty snacks: both income-eligible and higher-income nonparticipants purchased significantly more calories from salty snacks than SNAP participants did (mean difference: +11.92 kcal · person^{-1} · d^{-1} for income-eligible nonparticipants and +10.77 kcal · person^{-1} · d^{-1} for higher-income nonparticipants; both $P < 0.0001$). Higher-income nonparticipants purchased slightly more calories from nonstarchy vegetables than current SNAP participants did (mean difference: +1.58 kcal · person^{-1} · d^{-1}; $P < 0.0001$) but slightly fewer calories from starchy vegetables (mean difference: −2.87 kcal · person^{-1} · d^{-1}; $P < 0.0001$). There were no significant differences across groups in purchases of total vegetables, legumes, nuts, other dairy, desserts and sweet snacks, candy and gum, or junk foods.

There were differences across subgroups for purchases of the following 2 beverage groups: SSBs and 100% juice. Income-eligible nonparticipants purchased significantly fewer calories from SSBs than did current SNAP participants (mean difference: −14.98 kcal · person^{-1} · d^{-1}; $P < 0.0001$) as did higher-income nonparticipants (mean difference: −20.52 kcal · person^{-1} · d^{-1};

TABLE 1
Sample characteristics by SNAP status in Nielsen Homescan data pooled across quarter 4 of 2012 and quarters 2 and 4 of 2013 (n = 98,256)[1]

Characteristic	Current SNAP participant	Income-eligible nonparticipant	Higher-income nonparticipant	P
Household size, n	2.36 ± 1.47[2]	2.32 ± 1.47	2.24 ± 1.14	<0.001
Children, n	0.49 ± 0.99	0.44 ± 0.94	0.31 ± 0.75	<0.001
Any, % (n)	26 (1825)	23 (1383)	18 (15,592)	<0.001
Children per household by age, % (n)				
<2 y	1 (61)	1 (45)	0.4 (376)	<0.001
2–5 y	8 (551)	6 (343)	4 (3661)	<0.001
6–11 y	13 (887)	10 (602)	8 (6531)	<0.001
12–18 y	15 (1059)	15 (920)	11 (9624)	<0.001
Married, % (n)	39 (2688)	45 (2656)	67 (57,171)	<0.001
Household head age, y	55.50 ± 11.88	59.07 ± 12.97	59.28 ± 12.29	<0.001
Race/ethnicity of household head, % (n)				
Non-Hispanic white	77 (5375)	82 (4883)	83 (70,973)	<0.001
Hispanic	5 (370)	4 (247)	4 (3651)	<0.001
Non-Hispanic black	14 (951)	8 (502)	8 (6710)	<0.001
Non-Hispanic other	4 (263)	6 (325)	5 (4006)	<0.001
Educational attainment (highest in household), % (n)				
High school or less	30 (2085)	30 (1799)	14 (12,161)	<0.001
Some college	39 (2710)	35 (2063)	28 (23,587)	<0.001
College graduate	26 (1795)	27 (1621)	38 (32,485)	<0.001
Postcollege graduate	5 (369)	8 (474)	20 (17,107)	<0.001
Household income, % of the FPL	1.50 ± 1.09	0.89 ± 0.30	3.83 ± 1.65	<0.001
Observations, n	6959	5957	85,340	—

[1] Sample size is the number of household-by-quarter observations. Analyses are those of the authors, and calculations were based in part on data that were reported by The Nielsen Co. through its Homescan service for the 52-wk periods ending on 31 December 2012 and 31 December 2013. Nielsen data are licensed from The Nielsen Co., 2017. P values were determined with ANOVA tests (for means) or chi-square tests (for proportions) for the comparison of current SNAP participants, income-eligible nonparticipants, and higher-income nonparticipants. FPL, Federal Poverty Level; SNAP, Supplemental Nutrition Assistance Program.
[2] Mean ± SD (all such values).

$P < 0.0001$). In addition, higher-income nonparticipants purchased slightly more calories from juice than did current SNAP participants (mean difference: +2.05 kcal · person^{-1} · d^{-1}; $P < 0.0001$). There were no significant differences across groups in purchases of alcohol or milk.

There were also significant differences in purchases of nutrients across groups. Both income-eligible and higher-income nonparticipating households purchased considerably fewer total calories than did current SNAP participants [mean differences: −63.08 kcal · person^{-1} · d^{-1} ($P = 0.0002$) and −69.97 kcal · person^{-1} · d^{-1} ($P < 0.0001$), respectively]. Both groups of nonparticipants also purchased fewer grams of sugar than did current SNAP participants [mean differences: −6.73 g · person^{-1} · d^{-1} for income-eligible nonparticipants ($P < 0.0001$); −8.08 g · person^{-1} · d^{-1} for higher-income nonparticipants ($P < 0.0001$)] and fewer milligrams of sodium (mean difference: −170.34 mg · person^{-1} · d^{-1} for income-eligible nonparticipants, $P < 0.0001$; −194.80 mg · person^{-1} · d^{-1} for higher-income nonparticipants, $P < 0.0001$). Finally, income-eligible nonparticipant households purchased more grams of fiber than did current SNAP households (mean difference: +0.52; $P = 0.0002$) as did higher-income nonparticipants (mean difference: +0.52; $P < 0.0001$). There were no significant differences in purchases of total saturated fat ($P > 0.05$).

Sensitivity analyses

To account for the selection in the sample of households with nonmissing SNAP data, we also ran models with time-varying IPWs for the likelihood of reporting SNAP participation status. Results were highly robust to the use of the IPWs (Table 2). In addition, we ran models in which observations that were potential false positives for SNAP participation (i.e., reported current SNAP participation and reported income >130% or >185% of the FPL) were excluded from the analysis. In general, results were not sensitive to the exclusion of these cases (**Supplemental Table 4**). For example, the same pattern of significant differences across SNAP subgroups remained for fruit, nonstarchy vegetables, processed meats, SSBs, total calories, total sugars, and total sodium. Most food, beverage, and nutrient outcomes that did not show significant differences across groups when all participants were examined continued to show no significant differences in the models that excluded potential false positives, and for most outcomes, the direction of association (although still insignificant) remained the same. For a few outcomes (e.g., salty snacks, starchy vegetables, and fiber), differences between groups were similar in magnitude across models but lost significance at the Bonferroni-corrected α level ($P = 0.0023$) in ≥1 of the models that excluded potential false positives. In addition, for a small number of outcomes (e.g., desserts and sweet snacks), nonsignificant associations reversed sign (although, in all instances, these associations remained small in magnitude and statistically indistinguishable from zero regardless of the model).

DISCUSSION

By using a large data set of store food and beverage purchases from households across the United States, we found that

TABLE 2
Per-person household purchases of selected food, beverage, and nutrient groups in current SNAP participants, income-eligible nonparticipants, and higher-income nonparticipants (n = 98,256)[1]

				Multivariate adjusted		IPW	
	Unadjusted mean	Unadjusted median	Multivariate adjusted mean ± SE	Adjusted mean difference	P	Adjusted mean difference	P
Food group							
Fruit, kcal · person^{-1} · d^{-1}							
Current participants	22.84	9.44	26.82 ± 0.71	Referent	—	Referent	—
Eligible nonparticipants	26.24	11.06	31.18 ± 0.85	+4.35[2]	<0.0001	+4.18[2]	<0.0001
Higher-income nonparticipants	31.95	15.90	31.28 ± 0.23	+4.46[2]	<0.0001	+4.25[2]	<0.0001
Vegetables, kcal · person^{-1} · d^{-1}							
Nonstarchy							
Current participants	18.61	11.99	20.42 ± 0.33	Referent	—	—	—
Eligible nonparticipants	18.53	11.95	21.58 ± 0.37	+1.16	0.0095	+1.08	0.0110
Higher-income nonparticipants	22.36	15.67	22.00 ± 0.11	+1.58[2]	<0.0001	+1.39[2]	<0.0001
Starchy							
Current participants	35.79	23.35	32.62 ± 0.67	Referent	—	—	—
Eligible nonparticipants	31.86	20.00	30.11 ± 0.63	−2.51	0.0043	−2.24	0.0053
Higher-income nonparticipants	29.37	19.73	29.75 ± 0.15	−2.87[2]	<0.0001	−2.58[2]	<0.0001
Total							
Current participants	51.76	38.09	50.41 ± 0.82	Referent	—	—	—
Eligible nonparticipants	47.50	35.00	48.76 ± 0.83	−1.66	0.1324	−1.47	0.1506
Higher-income nonparticipants	48.97	38.50	48.99 ± 0.20	−1.42	0.1003	−1.27	0.1063
Legumes, kcal · person^{-1} · d^{-1}							
Current participants	8.21	1.15	8.00 ± 0.26	Referent	—	—	—
Eligible nonparticipants	8.01	0.57	7.68 ± 0.29	−0.32	0.3930	−0.40	0.2580
Higher-income nonparticipants	7.65	1.92	7.69 ± 0.07	−0.31	0.2666	−0.36	0.1769
Nuts, kcal · person^{-1} · d^{-1}							
Current participants	22.88	0.00	22.61 ± 1.16	Referent	—	—	—
Eligible nonparticipants	24.69	0.00	25.06 ± 0.97	+2.45	0.0877	+2.27	0.0691
Higher-income nonparticipants	25.44	0.00	25.43 ± 0.25	+2.82	0.0186	+2.71	0.0073
Other dairy, kcal · person^{-1} · d^{-1}							
Current participants	71.57	49.86	73.14 ± 1.16	Referent	—	—	—
Eligible nonparticipants	65.69	47.35	72.41 ± 1.12	−0.73	0.6287	−0.45	0.7409
Higher-income nonparticipants	74.62	58.32	74.02 ± 0.29	+0.88	0.4656	+1.06	0.3340
Processed meat, kcal · person^{-1} · d^{-1}							
Current participants	63.39	41.59	57.22 ± 1.08	Referent	—	—	—
Eligible nonparticipants	52.86	34.24	48.81 ± 1.03	−8.41[2]	<0.0001	−7.81[2]	<0.0001
Higher-income nonparticipants	47.99	32.41	48.77 ± 0.25	−8.44[2]	<0.0001	−7.69[2]	<0.0001
Desserts and sweet snacks, kcal · person^{-1} · d^{-1}							
Current participants	165.01	118.49	151.77 ± 2.69	Referent	—	—	—
Eligible nonparticipants	153.24	109.13	143.60 ± 2.52	−8.17	0.0161	−7.65	0.0136
Higher-income nonparticipants	146.20	108.74	147.96 ± 0.62	−3.81	0.1785	−2.69	0.2917
Salty snacks, kcal · person^{-1} · d^{-1}							
Current participants	132.39	96.03	134.40 ± 2.02	Referent	—	—	—
Eligible nonparticipants	134.89	99.13	146.31 ± 2.14	+11.92[2]	<0.0001	+10.97[2]	<0.0001
Higher-income nonparticipants	146.13	113.53	145.17 ± 0.58	+10.77[2]	<0.0001	+9.57[2]	<0.0001
Sweeteners and toppings, kcal · person^{-1} · d^{-1}							
Current participants	87.67	39.57	78.52 ± 2.10	Referent	—	—	—
Eligible nonparticipants	75.67	33.71	67.71 ± 2.02	−10.81[2]	0.0001	−10.48[2]	<0.0001
Higher-income nonparticipants	65.36	31.16	66.66 ± 0.48	−11.86[2]	<0.0001	−10.73[2]	<0.0001
Candy and gum, kcal · person^{-1} · d^{-1}							
Current participants	91.44	48.78	93.98 ± 3.18	Referent			
Eligible nonparticipants	90.03	47.55	99.57 ± 3.50	+5.59	0.2449	+4.58	0.2272
Higher-income nonparticipants	96.43	55.69	95.55 ± 0.84	+1.57	0.6425	+1.85	0.4788
Junk food,[3] kcal · person^{-1} · d^{-1}							
Current participants	476.50	381.28	458.66 ± 6.14	Referent	—	—	—
Eligible nonparticipants	453.82	363.75	457.49 ± 6.00	−1.47	0.8564	−2.59	0.7168
Higher-income nonparticipants	454.11	378.51	455.33 ± 1.51	−3.33	0.6069	−2.00	0.7230

(Continued)

TABLE 2 (*Continued*)

				Multivariate adjusted		IPW	
	Unadjusted mean	Unadjusted median	Multivariate adjusted mean ± SE	Adjusted mean difference	*P*	Adjusted mean difference	*P*
Beverage							
Sugar sweetened, kcal · person^{-1} · d^{-1}							
Current participants	88.62	40.33	73.60 ± 2.30	Referent	—	—	—
Eligible nonparticipants	68.59	26.59	58.63 ± 2.13	−14.98[2]	<0.0001	−13.49[2]	<0.0001
Higher-income nonparticipants	51.16	21.04	53.08 ± 0.45	−20.52[2]	<0.0001	−18.54[2]	<0.0001
Alcohol, kcal · adult^{-1} · d^{-1}							
Current participants	30.85	0.00	39.64 ± 2.08	Referent	—	—	—
Eligible nonparticipants	30.97	0.00	40.48 ± 2.17	+0.85	0.7512	+1.41	0.5734
Higher-income nonparticipants	40.21	0.00	38.83 ± 0.59	−0.80	0.7135	−0.22	0.9129
Milk, kcal · person^{-1} · d^{-1}							
Current participants	15.80	0.00	13.46 ± 0.82	Referent	—	—	—
Eligible nonparticipants	12.62	0.00	11.88 ± 0.83	−1.58	0.1561	−1.47	0.1338
Higher-income nonparticipants	11.38	0.00	11.62 ± 0.20	−1.84	0.0343	−1.53	0.0443
100% juice, kcal · person^{-1} · d^{-1}							
Current participants	13.44	3.57	14.00 ± 0.45	Referent	—	—	—
Eligible nonparticipants	14.44	3.59	15.86 ± 0.55	+1.86	0.0046	+1.86	0.0031
Higher-income nonparticipants	16.19	5.76	16.05 ± 0.15	+2.05[2]	<0.0001	+2.03[2]	<0.0001
Nutrients							
Total energy, kcal · person^{-1} · d^{-1}							
Current participants	1602.56	1430.15	1537.40 ± 13.77	Referent	—	Referent	—
Eligible nonparticipants	1469.34	1305.69	1474.32 ± 12.14	−63.08[2]	0.0002	−59.48[2]	0.0001
Higher-income nonparticipants	1462.46	1339.68	1467.42 ± 3.04	−69.97[2]	<0.0001	−61.24[2]	<0.0001
Saturated fat, g · person^{-1} · d^{-1}							
Current participants	26.57	19.38	25.86 ± 1.25	Referent	—	—	—
Eligible nonparticipants	23.02	17.62	23.17 ± 0.89	−2.69	0.0609	−2.13	0.0525
Higher-income nonparticipants	23.53	18.28	23.57 ± 0.24	−2.29	0.0769	−1.68	0.0879
Sugar, g · person^{-1} · d^{-1}							
Current participants	109.76	89.27	102.16 ± 1.26	Referent	—	—	—
Eligible nonparticipants	98.28	79.86	95.43 ± 1.16	−6.73[2]	<0.0001	−6.24[2]	<0.0001
Higher-income nonparticipants	93.26	79.84	94.08 ± 0.27	−8.08[2]	<0.0001	−6.99[2]	<0.0001
Fiber, g · person^{-1} · d^{-1}							
Current participants	10.28	8.67	10.59 ± 0.11	Referent	—	—	—
Eligible nonparticipants	10.26	8.76	11.11 ± 0.11	+0.52[2]	0.0002	+0.48[2]	0.0002
Higher-income nonparticipants	11.19	9.78	11.10 ± 0.028	+0.52[2]	<0.0001	+0.48[2]	<0.0001
Sodium, mg · person^{-1} · d^{-1}							
Current participants	2763.75	2236.02	2616.87 ± 30.85	Referent	—	—	—
Eligible nonparticipants	2464.84	1965.01	2446.03 ± 30.86	−170.34[2]	<0.0001	−169.91[2]	<0.0001
Higher-income nonparticipants	2409.12	1991.07	2422.41 ± 7.41	−194.80[2]	<0.0001	−176.24[2]	<0.0001

[1] Sample size is the number of household-by-quarter observations. Unadjusted means and medians were derived from regressions of purchase outcomes on SNAP status with no covariates. Multivariate adjusted estimates are from regressions that were controlled for the following variables: household composition [household size, presence of any children, number of children, presence of children in 4 age groups (<2, 2–5, 6–11, and 12–18 y)] and household structure (married compared with not); education [indicators for maximum educational attainment in the household (high school, some college, college graduate, and postcollege)]; race/ethnicity (indicators for the head of household were non-Hispanic white, Hispanic, non-Hispanic Black, and non-Hispanic other race/ethnicity); income (total household income as the percentage of the Federal Poverty Level); age of the household head (man or women, whomever was older); market indicators; year; and total number of purchases during the quarter. The IPW model was controlled for these variables, and weights observations were controlled for the inverse probability of observing SNAP status. SEs in the multivariate-adjusted and IPW models accounted for clustering at the household level. Analyses are those of the authors, and calculations were based in part on data that were reported by The Nielsen Co. through its Homescan service for the 52-wk periods ending on 31 December 2012 and 31 December 2013. Nielsen data are licensed from The Nielsen Co., 2017. IPW, inverse-probability weighted; SNAP, Supplemental Nutrition Assistance Program

[2] Significantly different from zero at a Bonferroni-corrected α level of 0.0023.

[3] Sum of the categories of desserts and sweet snacks, candy, sweeteners and toppings, and salty snacks.

households purchased considerable quantities of less-healthful foods and beverages (e.g., junk foods and SSBs) and nutrients (e.g., sodium and saturated fat). Household store purchases do not perfectly equate to individual consumption (e.g., because of waste and FAFH purchases) and, therefore, cannot be directly compared with dietary guidelines. However, we found that mean household purchases exceeded Dietary Guidelines for Americans 2015–2020 recommendations (45) for saturated fat and sodium from store purchases alone [i.e., not including FAFH, which is typically high in these nutrients (46)]. This finding is concerning because the high consumption of these nutrients may increase risk of poor health outcomes (47, 48). We also found that there

were both similarities and differences in household purchases between SNAP households and income-eligible and higher-income nonparticipating households. Although we found no significant differences by SNAP status for several purchase outcomes (e.g., total purchases of vegetables, desserts and sweet snacks, junk food, alcohol, and saturated fat), we also found that, along several dimensions, households who participated in SNAP had less-healthful purchases than did both groups of nonparticipants. For example, SNAP households purchased more calories from SSBs and processed meats, more total calories, sodium, and sugars, fewer calories from fruit and nonstarchy vegetables, and less fiber.

To our knowledge, only one other academic study has used purchase data to examine purchases of specific items in SNAP households (14). The study, which examined grocery store shoppers in New England, also found that participants in SNAP purchased more SSBs than did nonparticipants (14). Although our data cannot be used to directly infer dietary intake, many of our results are consistent with findings from studies with the use of dietary intake data. For example, Leung et al. (7) also found that SNAP participants reported lower intakes of fruit and fiber and higher intakes of processed meats, sweets and desserts, and SSBs than did income-eligible nonparticipants. Likewise, Bleich et al. (9) report higher SSB consumption in SNAP participants than in higher-income nonparticipants, and Cole and Fox (49) found that SNAP participants consumed fewer salty snacks and more sodas than did higher-income nonparticipants. However, some studies have shown no differences in SSB consumption between participants and nonparticipants (8).

There are several possible explanations for the observed differences between SNAP participant and nonparticipant food, beverage, and nutrient purchases. For example, although our models controlled for many demographic and geographic variables, there may have been other confounding variables that we were unable to account for. Self-selection bias is also possible in that households that choose to participate in SNAP may be different from households that do not participate in ways that affect their purchases (50). SNAP could also have played a causal role in some of the observed differences in purchases. For example, other authors have argued that SNAP has a small, negative causal effect on fiber intake in children (51). Finally, some differences may reflect the data used. For example, SNAP participants' lower packaged fruit and vegetables purchases could reflect a preference for bulk (nonpackaged) produce, which was not captured in the Homescan data. Because we lacked data on random-weight purchases, we could not assess this possibility.

Although we cannot ascertain from the current data the reasons that SNAP households' purchasing patterns differ from nonparticipants, our results suggest several areas with room for improvement in the nutritional profile of store purchases in both SNAP and non-SNAP households alike. In SNAP, potential policy levers include education, incentives, and restrictions. For example, several jurisdictions have proposed policies to end SNAP subsidies for items such as SSBs, candy, and junk foods, and the US House Committee on Agriculture recently debated the pros and cons of restricting SNAP benefits (52). Our results suggest that current purchasing amounts are high enough ($\sim$89 kcal $\cdot$ person^{-1} $\cdot$ d^{-1} from SSBs and $\sim$476 kcal $\cdot$ person^{-1} $\cdot$ d^{-1} from junk foods, for a total of $\sim$565 kcal $\cdot$ person^{-1} $\cdot$ d^{-1} from these categories combined) that meaningful reductions in total calories purchased could be achieved with even small proportional reductions in purchases of these products. For example, if a junk-food restriction reduced purchases by just 10%, the total calories purchased would be reduced by $\sim$47 kcal $\cdot$ person^{-1} $\cdot$ d^{-1} (476 kcal times 10%), which would be potentially large enough to affect body weight if translated into consumption reductions (53). However, the effectiveness and ethics of imposing restrictions on SNAP benefits have been subject to considerable debate (2, 54, 55), and a recent randomized trial suggested that restrictions are most effective when accompanied by incentives for healthy purchases (56).

Because non-SNAP households, regardless of income-eligibility, also showed room for improvement in the nutritional quality of store purchases, broadly targeted interventions are also indicated. For example, SSB taxes may reduce SSB consumption (57, 58), and incentives for purchasing healthier foods could improve the nutritional profile of household purchases (18, 19, 59, 60). The US might also follow other countries in adopting nonfiscal strategies such as imposing marketing restrictions or requiring warning labels on unhealthy items (61).

We note several strengths and limitations. As discussed, this article was descriptive in nature, and we could not ascertain any causal impacts of SNAP participation. In addition, there were missing data and potential misreporting of SNAP participation in our sample. Although we used IPW models and sensitivity analyses to mitigate these issues, there may still have been unaccounted for measurement errors and missing data in the SNAP variable that could have biased the associations (41). Future work could benefit from the use of data with administratively verified SNAP status. Other data limitations include that the Homescan data do not capture nonpackaged items without a barcode such as bulk produce, and results for total fruit and vegetables purchases are likely underestimates. Homescan participants also do not record purchases from away-from-home (FAFH) sources (e.g., at restaurants), and we likely underestimated purchases of nutrients that are common in FAFH such as sodium and saturated fat (46). In addition, our sample had different demographic characteristics than those of a nationally representative sample of SNAP participants and nonparticipants (Supplemental Table 1), and our results may not represent all SNAP and non-SNAP households because household food and beverage purchases may be correlated with these demographic variables [e.g., race/ethnicity (62, 63)]. Finally, our outcomes were aggregated at the household level, and thus do not necessarily represent any one member of the household, nor do the purchases equate to consumption.

This study also has several strengths. To our knowledge, ours is the first study to use purchase data to describe household packaged food and beverage purchases in a large sample of SNAP participants and the first study to examine purchases across several key food, beverage, and nutrient groups that are relevant to both health outcomes and current policy debates. Because every dietary assessment methodology has limitations, drawing on a novel data-collection technique helped us to triangulate previous work on SNAP participants' diet-related behaviors. In addition, we conducted a variety of sensitivity analyses, which increase confidence in the robustness of the results.

SNAP is the largest nutrition assistance program in the United States and the only federal food program that does not regulate the nutritional quality of the items it subsidizes (54). This study suggests that there is considerable room for improvement in the nutritional quality of packaged food and beverage purchases in

SNAP households and highlights particular areas to target. Non-SNAP households also have room for improvement in their food and beverage purchases, and broad initiatives could improve the nutritional quality of purchases for all US households. Because of the persistence of diet-related diseases such as obesity and diabetes in the US, a better understanding of how to improve household food purchases and, ultimately, diets could have meaningful public health implications.

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