

1 **Diet Quality Over the Monthly Supplemental Nutrition Assistance Program**
2 **Cycle**
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14 **Word Count:** 3,031

15 **Pages:** 19

16 **Tables:** 3

17 **Figures:** 1

18 **Conflicts of Interest:** The authors declare no conflict of interest.

19 **Financial Disclosures:** The authors have no financial disclosures.
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Abstract

Introduction: SNAP benefits, which are distributed monthly, help low-income families put food on their tables. Both food spending and caloric intake among recipients decrease over the month following benefit receipt. This pattern, termed the “SNAP-cycle”, has serious implications for health and food security of low-income households. To understand better the SNAP-cycle, this study explored: 1) differences in diet quality between SNAP and non-SNAP households, and 2) the association between the SNAP-cycle and diet quality.

Methods: Multivariate linear regression with SNAP households in the USDA’s Food Acquisition and Purchase Survey (FoodAPS) to evaluate changes in diet quality as time from SNAP distribution increased. Diet quality of food purchases was measured by Healthy Eating Index-2010 (HEI-2010) total and component scores. Data were collected 2012-13 and analyzed 2016-17.

Results: Overall dietary quality was low throughout the SNAP-cycle ($n=1,377$, mean HEI: 46.14 out of 100). SNAP households had significantly lower HEI scores compared to eligible and ineligible non-participants ($p<0.05$). After controlling for covariates, households in the final 10 days of the benefit cycle had HEI-2010 total scores 2.95 points lower than all other SNAP households ($p=0.02$). Significant declines in HEI fruit and vegetable scores contributed to worsening diet quality over the SNAP-cycle.

Conclusions: This study provides evidence of low dietary quality throughout the SNAP-cycle with significantly lower HEI scores in the final 10 days of the benefit month. This suggests less healthy purchasing occurs when resources are diminished, but overall that current SNAP levels are insufficient to consistently purchase foods according to dietary guidelines.

Introduction

Food insecurity is a persistent problem in the U.S. that disproportionately impacts low-income, female-headed, and ethnic-minority households with children.¹ Nationally, 12.3% of households report food insecurity in the past year,¹ and despite fluctuations following the 2008 recession, this rate has shifted very little since the U.S. first measured domestic food insecurity in 1995.²

Food insecurity has negative dietary implications, including lower consumption of fruits and vegetables,³ an increase in disordered eating (e.g. skipping meals),⁴ and reduced nutritional intake.^{5,6} Food insecurity also has long-term health implications for mental health, cognitive development and risk of diet-related chronic disease.⁷⁻⁹

One way the U.S. addresses food insecurity is through the Supplemental Nutrition Assistance Program (SNAP, formerly Food Stamps). More than 44 million people, or roughly 1 in 7 Americans, received SNAP benefits in 2016. SNAP participants generally have lower overall diet quality compared to income-eligible and higher income non-participants,¹⁰ however national data suggest that food purchasing by SNAP households does not differ substantially from purchasing by non-SNAP households and that both groups buy foods inconsistent with the Dietary Guidelines for Americans (DGA).¹¹

While SNAP has been shown to improve very low food security by roughly one third,¹² some SNAP households still report times of food insecurity. Studies of SNAP participants showing a decrease in benefit expenditure on a monthly time-scale have illustrated this periodic food insecurity.¹³⁻¹⁶ SNAP benefits are distributed once per month, and system-wide assessments

show the majority of recipients spend most of their benefits within two weeks after receiving them, typically running out before the end of the month.¹⁷ This monthly spending pattern is referred to as the SNAP-cycle. Prior researchers have posited that increasing the frequency of SNAP benefit distribution could alleviate this cyclic spending pattern.^{13,16}

The SNAP-cycle is associated with health and behavioral outcomes including hypoglycemia¹⁸ and decreased testing scores among school-aged children.²⁰ The number of days since benefit distribution is also significantly negatively associated with calorie consumption, particularly among infrequent shoppers, and increases the likelihood of days without eating.^{13,16,20,21} Others have found a U-shaped pattern in calorie and nutrient consumption with a dip in the middle of the SNAP-cycle, which may be attributable to higher energy density of foods purchased when money is scarce.²²

Despite common acknowledgment that a SNAP-cycle exists, longitudinal research exploring changes in dietary quality over this monthly time-scale is limited. Among the few existing studies, results are mixed.^{21,22} Additionally, limitations in the design of prior studies, such as single, 24-hour diet recall measures and small sample size, suggest that further inquiry is warranted. This study is the first to use a nationally representative dataset of food purchasing to evaluate the association between the SNAP-cycle and dietary quality. The USDA's Household Food Acquisition and Purchase Survey (FoodAPS)²³ provides a full week of food purchasing data for each household, which offers a more robust measure of diet quality than prior studies.

The aims of this study are to assess: 1) how diet quality of SNAP households compares to

eligible and non-eligible households within FoodAPS, and 2) the association between the SNAP-cycle and dietary quality of food purchases. Addressing these questions may inform policy decisions regarding SNAP benefit distribution to improve the dietary quality of SNAP recipients.

Methods

Study Sample

This study used FoodAPS to examine the relationship among SNAP recipient households between time since SNAP benefit receipt and the diet quality of food acquisitions (referred to in the paper as diet quality). FoodAPS was the first nationally representative survey of food purchasing and acquisition. Data were collected from 2012 to 2013 with a sample of 4,826 U.S. households (defined as all persons who live together and share food, and who were present at the sampled address during the data collection week) at a range of income levels, including an oversampling of SNAP-eligible households.²³ SNAP participation was determined by self-report and administrative matching (both caseload and alert data) to confirm that households reporting being on SNAP were currently receiving benefits.

Participating households completed an initial survey and were then trained to record and scan all their food purchases and acquisitions to be consumed at home (FAH) and away from home (FAFH) for a 7-day period. Researchers also conducted a final household interview and collected information relevant to food purchasing behaviors including income, household composition, and demographic characteristics. Nutritional content tabulated post hoc included food group servings equivalents for each item, making the calculation of Healthy Eating Index-2010 (HEI-

2010) scores possible. Analysis for this paper took place in 2016-2017 and used FAH nutrient data to evaluate the relationship between the SNAP-cycle and dietary quality.

Measures

When assessing mean HEI-2010 total and component scores, SNAP households were compared to eligible households not participating in SNAP (n=1,117) and non-eligible households (n=2,128). Non-eligible households were further divided for this analysis by 1) those households with income \geq 185% of Federal poverty guidelines (FPL) (n=1,792) and 2) those households with average income below 185% FPL (n=336). SNAP eligibility was determined by using the indicator simulated in FoodAPS (model run 4) based on income, assets and State-level eligibility guidelines.²³

The primary predictor variable was the number of *days since SNAP* benefits were distributed (DSS), which was defined as the number of days between date of last reported SNAP disbursement and the last day of the data collection week (*Figure 1*). Therefore, households with DSS 0-6 received their SNAP benefits during the data collection week, while a household with DSS=8 received their benefits two days prior to the start of their data collection week. For those households nearing the end of the benefit cycle at the time of the initial survey, it was assumed that they received their benefits on the same day the next month; therefore, their benefits would be renewed during the data collection week.

Primary outcome variables included diet quality of foods purchased, as measured by HEI-2010 scores applied to the full week of household purchases, total energy per person, as measured by

total kcal/100g, and total spending in dollars. The HEI-2010 was developed by the National Cancer Institute and USDA to measure how American diets compare to the DGA.²⁴ The HEI-2010 total score is comprised of 12 components – nine measured for adequacy (i.e. sufficient consumption for a person’s age and sex) and three for moderation. Because the index uses a density measure and follows a universal set of standards, it can be applied to measure and compare nutritional quality of foods at various scales including individual consumption or purchasing, restaurants, and the broader food environment.²⁵

Statistical Analysis

Analysis was conducted using STATA 14.2 software. To properly account for the complex sampling design of FoodAPS, sampling weights were applied and variance was estimated using the Jackknife Repeated Replication technique. Univariate and multivariate linear regression were used to determine changes in dietary quality as DSS increased. Univariate models where $p < 0.25$ were admitted into the full model. The DSS was run first as a continuous measure, with values 0-30 for the actual number of days since benefit receipt until the final day of a given household’s data collection week. Then, using visual inspection of the mean distribution of FAH purchases over the SNAP-cycle, the DSS variable was divided into time brackets to account for disproportionate food spending early in the benefit month. This bracketing was also informed by USDA program evaluations showing that most SNAP households go shopping within one day of receiving benefits and spend an average of 21.40% of their benefits on this first food shopping trip.¹⁷ Within this sample, the majority of food acquisitions occurred at the beginning of the SNAP-cycle (directly after receipt of benefits); therefore, time brackets of ≤ 2 , 3-9, 10-20, and

>20 days were used. Other time brackets, including models 1 (≤ 2 , 3-5, 6-19, >19), 2 (≤ 6 , 7-13, 14-20, >20), and 3 (≤ 6 , 7-13, 14-20, 21-27, >27) were also tested.

The DSS was also tested as a dichotomous variable for both 1) households receiving benefits during the data collection week versus all other households and 2) households in the final 10 days of the SNAP-cycle during the data collection week versus all other households. Sensitivity analysis was performed to determine whether different time bracketing substantively changed the outcomes. These analyses showed similar magnitudes of effect on total HEI-2010 scores, with slight variations in statistical significance above and below the $p<0.05$ level.

Potential covariates were selected based on past SNAP food spending literature. Correlational tests were performed for race/ethnicity, gender, education level, age of primary respondent, household income, household size, whether the household had a child, and residence in a metropolitan or non-metropolitan county. Other potential covariates, including physical access to food retail, household food insecurity status, and use of other food assistance programs (including WIC and USDA school lunch), were evaluated to ensure they did not influence the main research question. A robustness check was run using all potential covariates (showing similar magnitude and significance) and final regression models controlled for those variables that were significantly associated with outcomes.

Results

Of the full sample, 1,581 households received SNAP. After removing observations where households were missing data for date of SNAP distribution ($n=16$), had no FAH purchases

(n=182), or data-entry errors occurred in either macronutrient or household income values (n=6), 1,377 SNAP households remained. Most primary respondents were female (80.00%) and White (64.56%). Seventy-nine percent of households reported annual income lower than \$35k and nearly 62% had at least one child living in the home (*Table 1*).

Overall mean HEI-2010 of foods acquired by SNAP households was 46.14 out of 100 (*Table 2*). Among the sample, HEI-2010 component scores were relatively low; mean scores for total fruit, whole fruit, total vegetables, dairy, fatty acids, and empty calories were less than 50% of the maximum score for each category, meaning the quality of the mix of household food purchases was well below what is recommended by the DGA-2010. Scores for greens and beans and whole grains were on average lower than 20% of the maximum possible score.

After removing observations among non-SNAP households without any FAH purchases (n=325) and where there were extreme outliers in macronutrients (n=9), there were 992 eligible non-participating households, 303 lower-income ineligible households (income <185% FPL), and 1,616 ineligible households with income \geq 185% FPL. Compared to both eligible and non-eligible households, SNAP households had significantly lower total HEI-2010 scores ($p<0.05$) (*Table 2*). Higher-income ineligible households (\geq 185% FPL) had, on average, a 7.36-point greater total HEI score ($p<0.001$). Eligible non-participants had significantly better scores in several components, including total and whole fruits, total vegetables, whole grains, and empty calories. There were no significant differences among any of the sample groups for total protein, fatty acids, sodium or refined grains.

Among SNAP households, unadjusted mean HEI decreased by 0.11 points for every additional day since benefit distribution (95% CI: -0.24,0.02). When DSS was run as a dichotomous measure, HEI-2010 was 2.89 points lower among households in the final 10 days of the SNAP-cycle compared to all other SNAP households (CI: -5.39,-0.39). As a sensitivity analysis, when households with no FAH purchases were included and assigned an HEI score of zero, unadjusted mean HEI decreased by 0.23 points for each additional DSS (CI: -0.44,-0.02) and 4.63 points for households in the final 10 days of the SNAP-cycle (CI: -8.74,-0.51).

After controlling for significant covariates in the prediction model (race/ethnicity, income, age, college degree, marital status, metropolitan-area), mean HEI-2010 total score was 39.01 (CI: 32.80,45.22) for households who received their benefits on the final day of the data collection week (DSS=0) (*Table 3*). For each one-day increase in DSS, total HEI-2010 decreased by 0.12 points (CI: -0.25,0.00, $p=0.053$), however while the full model was significant at the $p<0.05$ level, DSS was not a significant predictor of diet quality when run as a continuous measure. With DSS as a dichotomous measure, households in the final 10 days of the SNAP-cycle had on average an HEI-2010 total score 2.95 points lower than those households within the first 20 days of the SNAP-cycle (CI: -5.31,-0.58, $p=0.02$). Among covariates, living in a metropolitan area and having a college degree, were significantly positively associated with dietary quality. Total vegetables was the only component score in the full model with a significant negative association with DSS (continuous) (*Table 3*). For those households in the final 10 days of the SNAP month, there were significant decreases in whole fruit and total vegetable scores. Sodium was the only component score to significantly improve in the final 10 days of the SNAP-cycle, indicating reduced acquisition of high-sodium foods.

Mean household spending for the data collection week was \$107 and energy per person was 17,226 (kcal/100g). After controlling for significant covariates, for each additional DSS, spending decreased \$3.82 (CI: -4.56,-3.08, $p<0.001$) and calorie acquisition per person decreased 652 (kcal/100g) (CI: -824.01,-478.29, $p<0.001$). Households in the final 10 days of the SNAP-cycle spent, on average, \$43.86 less (CI: -56.18,-31.54, $p<0.001$) and acquired 7,702 fewer calories per person (CI: -10233.45,-5170.06, $p<0.001$) compared to households at all other points of the SNAP-cycle.

Discussion

To our knowledge, this is the first study to use a nationally representative sample of household food purchasing to assess dietary patterns during the SNAP-cycle. Use of the HEI-2010, an extensively validated tool, provides a robust measure of dietary quality. Overall diet quality among the sample was low compared to the FoodAPS national average, which itself is only 51.95 of the total possible score of 100 reflecting perfect adherence to the DGA. SNAP household component scores reflect proportionally low acquisition of whole grains, seafood, fruits, and vegetables and high acquisition of empty calories, including sugar-sweetened beverages.

The lower diet quality of SNAP households compared to eligible non-participants and higher-income ineligible households is consistent with prior literature, and further highlights the degree to which SNAP households are struggling to meet dietary guidelines.¹⁰ The nutritional disparity exists not just for overall diet quality, where the average SNAP household HEI score was more

than 7 points lower than for higher-income non-eligible households, but also for HEI components. The proportion of food purchasing comprised of total and whole fruits was significantly lower for SNAP households than for all non-SNAP households, regardless of eligibility. Among eligible non-participants—those closest resembling SNAP households in terms of income and assets—fruit and vegetable component scores were more than 25% higher than among SNAP households ($p < 0.001$). These disparities may be explained, at least in part, by the relatively higher disadvantage that has been shown among income-eligible households who choose to participate in SNAP.²⁶

Aligned with prior SNAP-cycle literature, food spending and calorie acquisition among the sample decreased significantly as time from benefit distribution increased.^{13,16,21} A key finding from this study, however, is that dietary quality was low throughout the entire SNAP-cycle. There was a small, but significant 2.95-point decrease in HEI-2010 for households in the final 10 days of the SNAP-cycle compared to those households who were within 3 weeks of receiving SNAP. This decline in diet quality was largely attributable to decreased density among food acquisitions of fruits and vegetables. Households in the final 10 days of the SNAP-cycle had a 21% lower total vegetable score compared to all other SNAP households. Declines in diet quality at the end of the SNAP-cycle may be explained by depletion of resources with which to purchase more expensive, nutrient dense foods such as fruits and vegetables.^{27,28} As diet quality in this sample was notably low throughout the SNAP-cycle, not just in the final week, this suggests current benefit levels are insufficient to purchase foods in accordance with the DGA. While previous SNAP-cycle literature has hypothesized that changing the benefit distribution cycle may help with present-biased spending of benefits early in the month,¹⁶ the findings from this

study suggest that more frequent benefit disbursements are unlikely to significantly impact diet quality.

The modest changes in both total and component HEI scores should not be discounted, especially given the proportionally large declines in purchasing of certain foods. Low fruit and vegetable scores throughout the SNAP-cycle, and particularly at the end of the month, are concerning as fruit and vegetable consumption is an important protective factor against chronic disease.²⁹ Studies have shown that individuals who most closely follow the DGA have an 11-28% reduced risk of all-cause, cardiovascular disease and cancer mortality, and 16% and 18% lower major chronic disease and diabetes risk, respectively.³⁰⁻³³ These findings are particularly important in the context of this study, where the decline in diet quality at the end of the SNAP-cycle suggests the nutritional gap between SNAP households and the general population grows even larger during periods of the month. Addressing disparities in diet quality between SNAP participants and non-participants is a critically important step in reducing the higher rates of mortality among SNAP participants from diet related diseases including cardiovascular disease and diabetes.³⁴

Limitations

Study limitations relating largely to the FoodAPS dataset, discussed elsewhere,^{23,35,36} include lack of full-month purchasing data, reporting error in the date of SNAP receipt, and lack of food consumption data. The limitation of having only one week of purchasing data means that this study compares households at different points in the SNAP-cycle to each other, rather than evaluating changes during the SNAP-cycle within each household. Additionally, households

without any FAH purchases were omitted, as it was not possible to calculate an accurate HEI score for them. Lack of consumption data limits interpretation of the HEI scores, as the possibility cannot be ruled out that higher diet quality purchases made early in the month are stored and consumed later in the SNAP-cycle.

Future research should employ longitudinal methods and further explore the complex factors influencing food purchasing during the SNAP-cycle, including diet quality of restaurant and other away-from-home food purchases, as well as how SNAP interacts with other food assistance programs, such as WIC.

Conclusions

One of the most important contributions of this study is the finding that although SNAP beneficiaries experienced extremely low diet quality throughout the month, as measured using the HEI-2010, there was a significant drop in diet quality in the final 10 days of the benefit cycle, suggesting that insufficient benefits lead to poorer quality food purchases later in the month. These critically important social benefits define and constrain the food choices available to low-income Americans and therefore prove centrally important in determining the health of the population.

Acknowledgments

This project was supported with a grant from the University of Kentucky Center for Poverty Research through funding by the U.S. Department of Agriculture, Economic Research Service and Food and Nutrition Service, Agreement Numbers 58-5000-1-0050 and 58-5000-3-0066. B.C. was supported by an NIH/NHLBI training grant (T32 HL007034). The opinions and conclusions expressed herein are solely those of the authors and should not be construed as representing the opinions or policies of the sponsoring agencies.

The authors would like to acknowledge the following people for their contribution to this study: Roxanne Dupuis, MSPH, Carolyn Cannuscio, ScD, Robert Schnoll, PhD and E. Paul Wileyto, PhD.

Author Contributions

E.D.W., A.H. and B.C. conceptualized the manuscript; E.D.W. conducted the statistical analysis; E.D.W., A.H. and B.C. wrote the paper.

References

1. Coleman-Jensen A, Rabbit MP, Gregory CA, Singh A. *Household Food Security in the United States in 2015*. U.S. Department of Agriculture, Economic Research Service; 2016.
2. Chilton M, Rose D. A Rights-Based Approach to Food Insecurity in the United States. *Am J Public Health*. 2009;99(7):1203-1211. doi:10.2105/AJPH.2007.130229.
3. Robaina KA, Martin KS. Food Insecurity, Poor Diet Quality, and Obesity among Food Pantry Participants in Hartford, CT. *J Nutr Educ Behav*. 2013;45(2):159-164. doi:10.1016/j.jneb.2012.07.001.
4. Kendall A, Olson CM, Frongillo Jr. EA. Relationship of Hunger and Food Insecurity to Food Availability and Consumption. *J Am Diet Assoc*. 1996;96(10):1019-1024. doi:10.1016/S0002-8223(96)00271-4.
5. Bhattacharya J, Currie J, Haider S. Poverty, food insecurity, and nutritional outcomes in children and adults. *J Health Econ*. 2004;23(4):839-862. doi:10.1016/j.jhealeco.2003.12.008.
6. Mello JA, Gans KM, Risica PM, Kirtania U, Strolla LO, Fournier L. How Is Food Insecurity Associated with Dietary Behaviors? An Analysis with Low-Income, Ethnically Diverse Participants in a Nutrition Intervention Study. *J Am Diet Assoc*. 2010;110(12):1906-1911. doi:10.1016/j.jada.2010.09.011.
7. Franklin B, Jones A, Love D, Puckett S, Macklin J, White-Means S. Exploring Mediators of Food Insecurity and Obesity: A Review of Recent Literature. *J Community Health*. 2011;37(1):253-264. doi:10.1007/s10900-011-9420-4.
8. Berkowitz SA, Gao X, Tucker KL. Food-Insecure Dietary Patterns Are Associated With Poor Longitudinal Glycemic Control in Diabetes: Results From the Boston Puerto Rican Health Study. *Diabetes Care*. 2014;37(9):2587-2592. doi:10.2337/dc14-0753.
9. Institute of Medicine, Food and Nutrition Board. *Hunger and Obesity: Understanding a Food Insecurity Paradigm: Workshop Summary*. National Academies Press; 2011.
10. Andreyeva T, Tripp AS, Schwartz MB. Dietary quality of Americans by Supplemental Nutrition Assistance Program participation status: A systematic review. *Am J Prev Med*. 2015;49(4):594-604. doi:10.1016/j.amepre.2015.04.035.
11. Garasky S, Mbwana K, Romualdo A, Tenaglio A, Roy M. *Foods Typically Purchased by SNAP Households*. Prepared by IMPAQ International, LLC for USDA, Food and Nutrition Service; 2016.
12. Nord M, Golla AM. *Does SNAP Decrease Food Insecurity? Untangling the Self-Selection Effect*. U.S. Dept. of Agriculture, Economic Research Service.; 2009.

- 368 13. Wilde PE, Ranney CK. The Monthly Food Stamp Cycle: Shopping Frequency and Food
369 Intake Decisions in an Endogenous Switching Regression Framework. *Am J Agric Econ*.
370 2000;82(1):200-213.
- 371 14. Hastings J, Washington E. The First of the Month Effect: Consumer Behavior and Store
372 Responses. *Am Econ J Econ Policy*. 2010;2(2):142-162. doi:10.1257/pol.2.2.142.
- 373 15. Wiig K, Smith C. The art of grocery shopping on a food stamp budget: factors influencing
374 the food choices of low-income women as they try to make ends meet. *Public Health Nutr*.
375 2009;12(10):1726–1734. doi:10.1017/S1368980008004102.
- 376 16. Shapiro JM. Is there a daily discount rate? Evidence from the food stamp nutrition cycle. *J*
377 *Public Econ*. 2005;89(2):303–325. doi:10.1016/j.jpubeco.2004.05.003.
- 378 17. Castner L, Henke J. *Benefit Redemption Patterns in the Supplemental Nutrition Assistance*
379 *Program*. Alexandria, VA: U.S. Department of Agriculture, Food and Nutrition Service,
380 Office of Research and Analysis; 2011.
- 381 18. Seligman HK, Bolger AF, Guzman D, López A, Bibbins-Domingo K. Exhaustion Of Food
382 Budgets At Month's End And Hospital Admissions For Hypoglycemia. *Health Aff*
383 *(Millwood)*. 2014;33(1):116-123. doi:10.1377/hlthaff.2013.0096.
- 384 19. Gassman-Pines A, Bellows L. *SNAP Recency and Educational Outcomes*. Rochester, NY:
385 Social Science Research Network; 2015. <https://papers.ssrn.com/abstract=2701380>.
386 Accessed October 17, 2016.
- 387 20. Hamrick KS, Andrews M. SNAP Participants' Eating Patterns over the Benefit Month: A
388 Time Use Perspective. *PLOS ONE*. 2016;11(7):e0158422.
389 doi:10.1371/journal.pone.0158422.
- 390 21. Todd JE. Revisiting the Supplemental Nutrition Assistance Program cycle of food intake:
391 Investigating heterogeneity, diet quality, and a large boost in benefit amounts. *Appl Econ*
392 *Perspect Policy*. November 2014:ppu039. doi:10.1093/aepp/ppu039.
- 393 22. Kharmats AY, Jones-Smith JC, Cheah YS, et al. Relation between the Supplemental
394 Nutritional Assistance Program cycle and dietary quality in low-income African Americans
395 in Baltimore, Maryland. *Am J Clin Nutr*. 2014;99(5):1006–1014.
396 doi:10.3945/ajcn.113.075994.
- 397 23. *National Household Food Acquisition and Purchase Survey (FoodAPS): User's Guide to*
398 *Survey Design, Data Collection, and Overview of Datasets*. U.S. Department of
399 Agriculture, Economic Research Service; 2016.
- 400 24. Guenther PM, Kirkpatrick SI, Reedy J, et al. The Healthy Eating Index-2010 Is a Valid and
401 Reliable Measure of Diet Quality According to the 2010 Dietary Guidelines for Americans.
402 *J Nutr*. 2014;144(3):399-407. doi:10.3945/jn.113.183079.

25. Jahns L, Scheett A, Johnson L, et al. Diet Quality of Supermarket Sales Circulars measured by the Healthy Eating Index-2010. *FASEB J*. 2015;29(1 Supplement):132.5. doi:10.1016/j.jand.2015.09.016.
26. Laura Tiehen, Newman C, Kirlin JA. *The Food-Spending Patterns of Households Participating in the Supplemental Nutrition Assistance Program: Findings From USDA's FoodAPS*. U.S. Department of Agriculture, Economic Research Service; 2017.
27. Drewnowski A. Obesity and the food environment: Dietary energy density and diet costs. *Am J Prev Med*. 2004;27(3, Supplement):154-162. doi:10.1016/j.amepre.2004.06.011.
28. Drewnowski A, Darmon N. Food Choices and Diet Costs: an Economic Analysis. *J Nutr*. 2005;135(4):900-904.
29. Lock K, Pomerleau J, Causer L, Altmann DR, McKee M. The global burden of disease attributable to low consumption of fruit and vegetables: implications for the global strategy on diet. *Bull World Health Organ*. 2005;83(2):100-108.
30. Liese AD, Krebs-Smith SM, Subar AF, et al. The Dietary Patterns Methods Project: Synthesis of Findings across Cohorts and Relevance to Dietary Guidance. *J Nutr*. 2015;145(3):393-402. doi:10.3945/jn.114.205336.
31. Rathod AD, Bharadwaj AS, Badheka AO, Kizilbash M, Afonso L. Healthy Eating Index and Mortality in a Nationally Representative Elderly Cohort. *Arch Intern Med*. 2012;172(3):275-277. doi:10.1001/archinternmed.2011.1031.
32. McCullough ML, Feskanich D, Stampfer MJ, et al. Adherence to the Dietary Guidelines for Americans and risk of major chronic disease in women. *Am J Clin Nutr*. 2000;72(5):1214-1222.
33. Chiuve SE, Fung TT, Rimm EB, et al. Alternative Dietary Indices Both Strongly Predict Risk of Chronic Disease. *J Nutr*. June 2012. doi:10.3945/jn.111.157222.
34. Conrad Z, Rehm CD, Wilde P, Mozaffarian D. Cardiometabolic Mortality by Supplemental Nutrition Assistance Program Participation and Eligibility in the United States. *Am J Public Health*. 2017;107(3):466-474. doi:10.2105/AJPH.2016.303608.
35. Kirlin JA, Denbaly M. Lessons learned from the national household food acquisition and purchase survey in the United States. *Food Policy*. doi:10.1016/j.foodpol.2017.08.013.
36. *National Household Food Acquisition and Purchase Survey (FoodAPS): Codebook: Household-Level Public Use File*. U.S. Department of Agriculture, Economic Research Service; 2016.

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1 Table 1. Description of the Sample

	n	%
Total	1377	100.00
Age of Primary Respondent		
16-30	351	25.49
31-45	447	32.46
46-60	394	28.61
>60	185	13.44
Gender of Primary Respondent		
Male	276	20.04
Female	1,101	79.96
Married	391	28.40
Child in Home	851	61.80
Non-Metro County	128	9.30
Race of Primary Respondent		
White	889	64.56
Black/African American	274	19.90
Multiple/Other	213	15.47
Hispanic	349	25.34
Education level		
Less than high school	375	27.23
High school or GED	452	32.82
Some college	438	31.81
College graduate	111	8.06
Annual Household Income		
Less than \$15k	534	38.78
\$15-24,999k	346	25.13
\$25-34,999k	211	15.32
\$35-49,999k	145	10.53
\$50-74,999k	141	10.24

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3 GED, General Education Development

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6 Table 2. HEI-2010 Scores by SNAP Eligibility and Participation

HEI-2010 Score	Max. Score ^a	SNAP participants (n=1,377)	Eligible, non- participants (n=992)	Not SNAP Eligible	
				<185 FPL (n=303)	≥185 FPL (n=1616)
		Mean (SE)	Mean (SE)	Mean (SE)	Mean (SE)
Adequacy					
Total Fruit	5	1.80 (0.09)	***2.40 (0.10)	**2.28 (0.12)	***2.59 (0.08)
Whole Fruit	5	1.95 (0.12)	***2.75 (0.11)	**2.52 (0.15)	***2.81 (0.09)
Total Vegetables	5	2.24 (0.09)	***2.82 (0.09)	2.51 (0.14)	***2.84 (0.05)
Greens & Beans	5	0.86 (0.08)	***1.59 (0.11)	1.16 (0.13)	***1.62 (0.07)
Whole Grains	10	1.73 (0.11)	*2.13 (0.16)	2.05 (0.28)	***2.73 (0.12)
Total Dairy	10	4.64 (0.12)	4.91 (0.20)	4.40 (0.24)	***5.23 (0.10)
Total Protein Foods	5	3.46 (0.08)	3.26 (0.08)	3.61 (0.16)	3.35 (0.06)
Seafood and Plant Proteins	5	1.49 (0.10)	*1.83 (0.08)	1.76 (0.15)	***2.03 (0.09)
Fatty Acids	10	4.86 (0.17)	4.96 (0.24)	5.15 (0.27)	4.80 (0.11)
Moderation					
Refined Grains	10	6.68 (0.16)	6.85 (0.16)	7.40 (0.33)	6.94 (0.14)
Sodium	10	6.47 (0.16)	6.51 (0.26)	6.91 (0.37)	6.97 (0.14)
Empty Calories	20	9.98 (0.20)	***11.57 (0.27)	10.72 (0.67)	**11.58 (0.31)
Total Score	100	46.14 (0.56)	***51.57 (0.60)	*50.49 (1.32)	***53.50 (0.60)

Adjusted Wald tests, all compared to SNAP participants.

Boldface indicates statistical significance (* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$)

HEI-2010, Health Eating Index 2010

FPL, Federal Poverty Level

SNAP, Supplemental Nutrition Assistance Program

^a Scores based on adherence to recommendations from the Dietary Guidelines for Americans.
Higher scores equate to better diet quality.

Table 3. Adjusted Regression Models of Days Since SNAP on HEI-2010 Total Score

	Continuous Measure						Dichotomous Measure (DSS>20)					
	Total Score*		Total Vegetables*		Whole Fruits**		Total Score**		Total Vegetables**		Whole Fruits**	
	Coef. (95% CI)	P> t	Coef. (95% CI)	P> t	Coef. (95% CI)	P> t	Coef. (95% CI)	P> t	Coef. (95% CI)	P> t	Coef. (95% CI)	P> t
HEI-2010 Total Score	-0.12 (-0.25,0.00)	0.05	*-0.01 (-0.25,-0.00)	0.04	-0.03 (-0.06,0.00)	0.09	*-2.95 (-5.32,-0.58)	0.02	** -0.45 (-0.75,-0.16)	0.00	*-0.64 (-1.20,-0.08)	0.03
Race												
White	(Ref.)		(Ref.)		(Ref.)		(Ref.)		(Ref.)		(Ref.)	
Black/AA	-1.17 (-4.32,1.98)	0.45	-0.33 (-0.78,0.12)	0.14	-0.26 (-0.80,0.27)	0.32	-0.99 (-4.01,2.03)	0.51	-0.31 (-0.74,0.13)	0.16	-0.22 (-0.73,0.28)	0.38
Other / Multiple	1.71 (-2.24,5.66)	0.38	0.17 (-0.59,0.25)	0.40	*0.43 (0.02,0.84)	0.04	1.68 (-2.27,5.62)	0.40	-0.17 (-0.58,0.24)	0.40	*0.42 (0.03,0.82)	0.04
Monthly Income (hundreds)	0.01 (-0.04,0.07)	0.65	0.00 (-0.01,0.01)	0.71	0.01 (-0.00,0.01)	0.11	0.01 (-0.05,0.07)	0.69	0.00 (-0.01,0.01)	0.77	0.01 (-0.00,0.01)	0.15
Age	0.08 (-0.01,0.17)	0.08	0.11 (-0.00,0.02)	0.06	**0.02 (0.01,0.03)	0.01	0.08 (-0.01,0.17)	0.09	0.01 (-0.00,0.02)	0.07	*0.02 (0.00,0.03)	0.01
Married	1.28 (-1.68,4.23)	0.38	0.15 (-0.20,0.49)	0.40	-0.15 (-0.44,0.15)	0.31	1.24 (-1.72,4.21)	0.40	0.14 (-0.20,0.48)	0.40	-0.16 (-0.45,0.13)	0.28
Non-metro Area	** -4.68 (-7.73,-1.62)	0.00	*-0.57 (-1.13,-0.02)	0.04	-0.25 (-0.87,0.37)	0.41	** -4.74 (-7.83,-1.66)	0.00	*-0.58 (-1.14,-0.03)	0.04	-0.27 (0.089,0.36)	0.39
College Degree	*4.63 (0.32,8.93)	0.04	0.10 (-0.46,0.66)	0.72	0.54 (-0.12,1.21)	0.10	*4.73 (0.44,9.03)	0.03	0.11 (-0.45,0.66)	0.69	0.56 (-0.10,1.23)	0.09
Hispanic	0.94 (-3.53,5.41)	0.70	0.17 (-0.26,0.61)	0.42	**0.59 (0.18,1.01)	0.01	1.00 (-3.44,5.43)	0.65	0.18 (-0.25,0.61)	0.39	**0.61 (0.19,1.02)	0.01

Boldface indicates statistical significance (* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$)

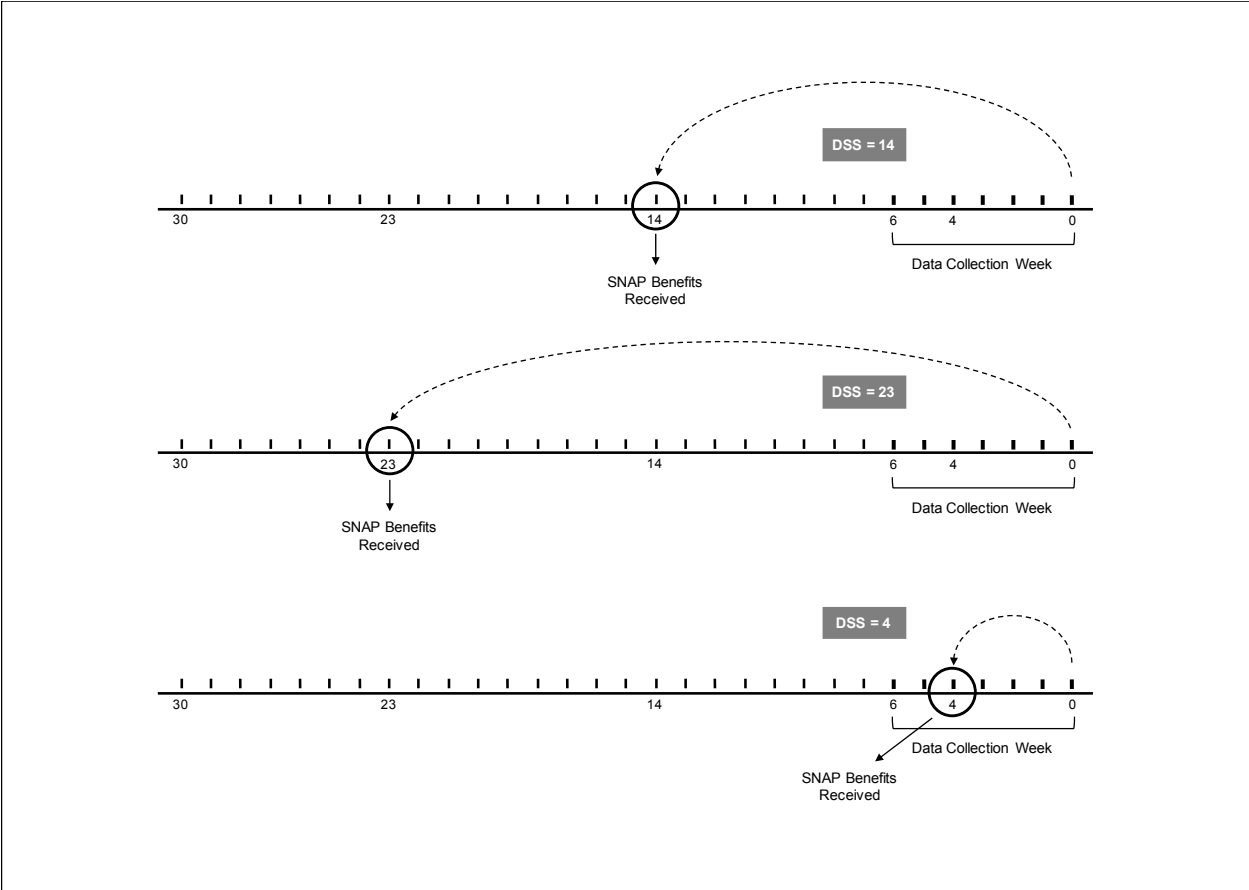
SNAP, Supplemental Nutrition Assistance Program

AA, African American

DSS, Days since SNAP

HEI-2010, Healthy Eating Index 2010

Figure



DSS, Days Since SNAP until the final day of data collection week.

