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“Doubling Up” on Produce at Detroit Farmers Markets: Patterns and Correlates of Use of a Healthy Food Incentive

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Abstract

Introduction—Federal food assistance programs such as the Supplemental Nutrition Assistance Program (SNAP) help address food insecurity, yet many participants still struggle to afford nutritionally adequate foods. The U.S. Department of Agriculture has committed \$100 million to the expansion and evaluation of SNAP healthy food incentives, which match SNAP funds spent on produce. However, little is known about who uses SNAP incentives or how often they are used.

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This study examines patterns and correlates of use of the SNAP incentive Double Up Food Bucks at all eight participating Detroit farmers markets during 2012–2013.

Methods—SNAP/Double Up Food Bucks transactions from handwritten farmers market logs ($n=21,541$) were linked with state administrative SNAP enrollment data. Frequency of incentive use and characteristics of Double Up Food Bucks users relative to the overall Detroit SNAP-enrolled population were examined, as were market-level characteristics associated with program use. Negative binomial regression was used to estimate predictors of repeat transactions (analyses conducted 2015–2017).

Results—Although demographic characteristics of Double Up Food Bucks users reflected those of the overall Detroit SNAP-enrolled population, Double Up Food Bucks users were poorer and disproportionately female. One third of Double Up Food Bucks users had more than one transaction during the 2-year period. Repeat transactions were directly correlated with identifying as white (incidence rate ratio=2.34, 95% CI=2.11, 2.59, $p<0.001$), and inversely correlated with driving distance from market of first transaction (incidence rate ratio=0.98 per mile, 95% CI=0.98, 0.99, $p<0.001$). Rates of repeat transactions also varied significantly by market.

Conclusions—Addressing barriers to initial use and return visits can help maximize the impact and reach of SNAP incentives among Americans at highest risk of diet-related disease.

INTRODUCTION

Federal food assistance programs such as the Supplemental Nutrition Assistance Program (SNAP) have been shown to significantly reduce food insecurity.¹ However, many SNAP enrollees report difficulty affording healthful foods, and fruit and vegetable consumption in SNAP households remains far below national dietary guidelines.^{2,3} One particularly promising approach to addressing these nutritional deficits is incentivizing fruit and vegetable purchases by matching SNAP funds spent on produce at farmers markets (FM) and other SNAP retailers.^{4–12} Since 2015 the U.S. Department of Agriculture (USDA) has awarded more than \$65 million through the Food Insecurity Nutrition Incentive program for the expansion and evaluation of these SNAP incentive programs, with \$100 million in funding committed by fiscal year 2018.¹³ There are currently SNAP incentive programs in almost every state.^{14,15}

Double Up Food Bucks (DUFb) is among the oldest and most established SNAP incentive programs. Launched in 2009 in Detroit, DUFb is currently accepted at >150 FM/farm stands and 80 grocery stores throughout Michigan. The majority of FM in Michigan operate only during the peak harvest months of May–November, although a growing number of FM are open year round. DUFb provides a 1:1 match of SNAP funds at participating markets, up to \$20 per visit, redeemable for Michigan-grown produce.¹⁴ SNAP sales at Michigan FM grew nearly 38-fold in the 5 years following the introduction of DUFb, reaching more than \$800,000 during July–October of 2013.¹⁶ DUFb maintains a particularly strong presence in Detroit, where 40% of residents live below the federal poverty level (FPL).¹⁷ In 2011, more than 19% of Detroit households were food insecure, reporting insufficient or uncertain access to nutritionally adequate foods during the prior year.¹⁸

A growing body of literature has shown that use of SNAP incentive programs is associated with both increased produce purchase and consumption.^{4–8,12} Prior studies analyzing aggregate sales data have also demonstrated that SNAP incentive programs are associated with population-level increases in SNAP sales at FM, produce sales at FM, or both.^{6,19,20} Based on findings from the USDA Healthy Incentives Pilot (HIP),⁴ Choi and colleagues²¹ estimated that implementing a similar incentive nationwide would lead to significant increases in fruit and vegetable consumption, decreases in consumption of refined grains, and reduced incidence of diabetes, obesity, and cardiovascular disease over the long term. Yet meaningful population health improvement through SNAP incentives necessitates adequate program uptake.

Little is known about the proportion of the SNAP-enrolled population using SNAP incentive programs such as DUFEB, frequency of incentive use, sociodemographic subsets of SNAP enrollees more likely to use SNAP incentives, or FM-level characteristics that may impact incentive use. This more nuanced understanding is critical to assess the potential scale and impact of SNAP incentives and identify possible drivers of program use. Accordingly, the authors examined all DUFEB transactions among SNAP enrollees over a 2-year period in Detroit, and compared sociodemographic characteristics of SNAP enrollees who had used DUFEB with the overall SNAP-enrolled population in Detroit.

METHODS

Study Sample

All SNAP and DUFEB transaction data from Detroit FM accepting SNAP/DUFEB during the 2012–2013 market seasons were linked with coded administrative data maintained by the State of Michigan. These linked datasets were then used to examine four specific research questions at Detroit FM: (1) rates and frequency of DUFEB transactions among all eligible SNAP enrollees during the 2012–2013 DUFEB seasons, as well as SNAP redemption amounts; (2) sociodemographic characteristics of SNAP enrollees using DUFEB; (3) how SNAP enrollees using DUFEB compared with the overall Detroit SNAP-enrolled population with respect to key sociodemographic factors; and (4) DUFEB user characteristics associated with repeat transactions.

All FM in Detroit process SNAP sales at a central location. SNAP shoppers swipe an Electronic Benefit Transfer (EBT) card—a debit card linked to their SNAP benefits—through a point-of-sale device at the market. Market staff provide the SNAP enrollee with tokens that may be used on any SNAP-eligible purchase at the market. The shopper then receives a matching amount, up to \$20 per visit, in separate DUFEB tokens redeemable for Michigan-grown produce. DUFEB tokens do not expire and may be used across DUFEB seasons.

Characteristics of Detroit FM are described in Table 2. Markets in Detroit are geographically spread across the city (Appendix Figure 1) and vary in size as well as hours and frequency of operation. Eastern Market, the largest and most well-established market, has \approx 250 vendors and 30,000–40,000 shoppers at their Saturday market. There are also a range of small to midsize markets. In 2012, seven Detroit FM accepted SNAP/DUFEB and eight

Detroit FM accepted SNAP/DUFB in 2013. In 2012 DUFB was accepted at Detroit markets from June to November; the 2013 season was 2 months shorter (July–October).

Copies of handwritten transaction logs were obtained from all Detroit FM accepting SNAP/DUFB during 2012–2013 (Appendix Figure 1). These logs were routinely recorded at the markets when individuals redeemed SNAP benefits. Transaction logs included market name, date of transaction, last four to eight digits (market dependent) of the shopper's EBT card, SNAP tokens disbursed, and amount of DUFB matched. The transaction logs did not include information on where shoppers redeemed their tokens, what was purchased with tokens, or the number of visits over which tokens were redeemed.

Data from handwritten transaction logs were entered into an electronic database. Accuracy was verified with double-data entry and electronic proofreading. Market-level transaction data from transaction logs were then linked with coded administrative SNAP-enrollee sociodemographic and monthly benefit data maintained by the State. State administrative data containing aggregate sociodemographic information was also obtained for the entire Detroit SNAP-enrolled population. Finally, descriptive characteristics for each market were collected from Detroit Community Markets, a partnership of local FM and farm stands.

Data were stored in a secure, password-protected database accessible only to study researchers. This study was determined to be exempt by the University of Michigan Medical School IRB.

Measures

Demographic characteristics of SNAP enrollees using DUFB at Detroit FM during the study period included gender, race, ethnicity, age, marital status, number of adults and children per household, and nine-digit residential ZIP code (used as a proxy for residential address). All demographic characteristics were obtained from the State administrative dataset following data linkage. Latitude and longitude associated with each nine-digit ZIP code was obtained through the online address validation service SmartyStreets.²² Driving distance from residential nine-digit ZIP code to FM of first transaction was then estimated through the Google Maps application programming interface using the latitude/longitude associated with each nine-digit ZIP code. Household economic indicators included gross monthly household income; household percentage of FPL; monthly SNAP enrollment status and benefit amount; monthly Medicaid enrollment status; and receipt on a per-month basis (yes/no) of (1) Temporary Assistance for Needy Families, (2) State Disability Assistance, and (3) State Emergency Relief. Characteristics of each FM included location, number of vendors, days and hours of operation, season length, average daily number of customers, and years accepting DUFB.

Primary outcomes were: (1) SNAP/DUFB transactions and (2) unique DUFB users at Detroit FM during the 2012–2013 DUFB seasons. Secondary outcomes included frequency of market SNAP/DUFB transactions by individual SNAP enrollees during the study period, distribution of transactions over time and by market, shopper sociodemographic characteristics associated with repeat transactions, and how SNAP enrollees using DUFB at

Detroit markets compared sociodemographically with the overall SNAP-enrolled Detroit population.

Statistical Analysis

Market-level transaction data was linked with coded administrative SNAP-enrollee data using the last four digits of the shopper's EBT card, transaction date, and market of transaction. A unique identifier was generated for each DUFB user with at least one recorded transaction. Transactions recorded in the handwritten market logs that lacked corresponding matches (based on last four EBT digits, transaction date, and market) in the state administrative data were excluded from analyses ($n=1,426$, 6.2%).

After linking the datasets, descriptive statistics were calculated for all variables, including sociodemographic characteristics, rates and frequency of DUFB transactions, and SNAP redemption amounts. Multivariable negative binomial regression models²³ were then used to estimate participant characteristics associated with repeat DUFB transactions over the 2-year study period. The margins post-estimation command was used to predict estimated number of repeat transactions.

The authors first examined the association between number of months participants were SNAP enrolled during the study period (total of 10 months over the 2012–2013 DUFB seasons) and repeat DUFB transactions. This association was then examined adjusting for the individual-level characteristics described in Table 3. Negative binomial regression models were analyzed in which driving distance from residential nine-digit ZIP code to FM of first transaction was modeled as a continuous variable. In sensitivity analyses modeling distance as a five-level categorical variable (0–1 miles, >1–5 miles, >5–10 miles, >10–15 miles, >15 miles) to allow for a possible nonlinear association between distance and repeat transactions, results were substantively unchanged. Extreme outliers with distance >100 miles were excluded from regression models ($n=200$, 0.9%). Stata, version 13.1 was used for all analyses, which were conducted in 2015–2017.

RESULTS

There were 21,541 confirmed SNAP/DUFB transactions during June–November 2012 and July–October 2013, resulting in a total of \$410,400 in SNAP benefits redeemed and an additional \$318,222 in distributed DUFB. The number of transactions each month was normally distributed over the DUFB season, with the greatest number of transactions (70%) occurring during the peak months of July–September. Both the median amount of SNAP benefits redeemed per transaction and the median DUFB match were \$20 (interquartile range, \$10–\$20; Table 1). Fifty-eight percent of SNAP transactions were at least \$20, thereby maximizing the \$20 DUFB match; 18% of SNAP transactions were >\$20 (range, \$1–\$500).

Eastern Market, open twice weekly and among the largest public markets in the country, accounted for 81% of SNAP/DUFB transactions during the study period. The smallest four markets each comprised <1% of SNAP transactions during the study period. Characteristics of Detroit FM are described in Table 2.

A total of 11,983 unique individuals used DUFEB over the study period. DUFEB users were predominantly female (72%), non-Hispanic black (74%), and in households living below the FPL (87%). Thirty percent were in households with zero gross annual income, and 42% had one or more children aged <18 years in the household. Two thirds of DUFEB users resided in Detroit, representing \cong 5% of the overall Detroit SNAP-enrolled population over the 2-year study period. Compared with the overall Detroit SNAP-enrolled populations, DUFEB users were more likely to be female and in households living below the FPL (Table 1).

Across all markets, DUFEB users averaged 1.8 SNAP/DUFEB transactions during the study period (SD=2.2, range, 1–51). Over the 2012–2013 DUFEB seasons 69% of DUFEB users had only a single SNAP/DUFEB transaction (Figure 1). Among the 10,437 (90%) of DUFEB users who were SNAP enrolled during both 2012 and 2013, 55% had transactions in 2012 alone, 34% had transactions in 2013 alone, and 11% had at least one transaction in each year. Adjusting for month and year of first transaction, multiple transactions were directly correlated with identifying as white (incidence rate ratio=2.34, 95% CI=2.11, 2.59, $p<0.001$) and inversely correlated with driving distance from residence to market of first transaction (incidence rate ratio=0.98 per mile, 95% CI=0.98, 0.99, $p<0.001$). Rates of repeat transactions also varied by FM. Medicaid receipt was negatively associated with multiple transactions (incidence rate ratio=0.82, 95% CI=0.74, 0.91, $p<0.001$). Gender, age, having children aged <18 years in the household, poverty status, and SNAP benefit amount were not significant in the model (Table 3).

DISCUSSION

During the 2012–2013 DUFEB seasons, SNAP enrollees across eight Detroit FM redeemed a total of \$410,400 in SNAP and received an additional \$318,222 in DUFEB. Approximately 5% of Detroit SNAP-enrolled households used SNAP/DUFEB at a Detroit FM. Although this percentage is far greater than the 1.4% of SNAP-enrolled households nationally using SNAP at a FM one or more times during fiscal years 2012 and 2013,^{24,25} it still represents a small minority of SNAP enrollees in Detroit. Sociodemographic characteristics of DUFEB users at Detroit markets largely reflected the characteristics of the Detroit SNAP-enrolled population, although the typical DUFEB user was poorer and more likely to be female. While nearly 12,000 SNAP-enrollees redeemed SNAP/DUFEB at a Detroit FM during the study period, 69% had only a single transaction. Correlates of repeat transactions included identifying as white and shorter driving distance from residence to market of first transaction. Rates of repeat transactions also varied by individual FM.

This study builds on prior work in several respects. Previous evaluations of incentive programs have generally relied on aggregate FM sales or self-reported information. These studies have found increases in SNAP transactions at participating markets after the introduction of incentives.^{6,19,20} Research has also found significant increases in incentive program participants' self-reported market use and fruit and vegetable purchases.^{5,6,26} However, these prior studies have generally not been able to capture individual-level transaction data or participant characteristics associated with program use. Three prior investigations did examine individual-level transaction data: the USDA Healthy Incentives

Pilot in Hampden County, Massachusetts,⁴ and the work of Freedman and colleagues^{19,27} at a FM in rural South Carolina.

Freedman and colleagues examined two different incentive models at a Federally Qualified Health Center-based FM in South Carolina. In a 2011 pilot, 41 patients with diabetes received two \$25 market vouchers (no out-of-pocket expenditure required) for the purchase of produce over 22 weeks. In 2012, a separate intervention provided up to \$5 per week for all customers spending at least \$5 in food assistance at the market ($n=336$). Although these studies found significant increases in use of food assistance at the FM¹⁹ and marginally significant increases in fruit and vegetable consumption,²⁷ participants visiting the single rural site may not have been representative of broader SNAP-enrolled populations.

The current study is among the first to examine use of an incentive in a broad SNAP-enrolled population using individual-level transaction data. The only prior study to do so, HIP, was a USDA-designed RCT in which 7,500 SNAP-enrolled families received a \$0.30 rebate for every dollar of SNAP benefits spent on targeted fruit and vegetables. Over a 14-month intervention period, participating families were able to redeem the incentive at 130 retailers, of which 16 (12%) were FM. The study found that HIP participants spent \$6.15 more per month on targeted fruits and vegetables compared with non-HIP households, and consumed 0.24 cup-equivalent more fruits and vegetables per day than the control group.⁴ In contrast to HIP, the current study was specific to FM and assessed use of an existing SNAP incentive program rather than a newly designed intervention. Additionally, the mechanism through which DUFB operates at Michigan FM—an up-front match—is distinct from the approach of the Freedman and colleagues studies (voucher, no match required)^{19,27} and HIP (electronic \$0.30 rebate per \$1.00 spent on incentivized items).⁴ The current study is also the first the authors are aware of to link individual-level FM transaction data with state administrative data to understand who is using SNAP incentive programs and patterns of use.

Particularly given the USDA's \$100 million commitment to SNAP incentives through the Food Insecurity Nutrition Incentive program—and any future funding that might be authorized in the next Farm Bill—this study offers important implications for policymakers, program sponsors, community leaders, and researchers. First, although the 5% of Detroit SNAP enrollees using SNAP/DUFB at Detroit FM during the 2012–2013 DUFB seasons was considerably higher than the rate of SNAP use at FM nationally, there are significant opportunities to increase incentive program use. Whereas outreach efforts have historically focused on increasing awareness of incentive availability, the current study suggests that facilitating return use is also critically important. Second, the study showed that rates of return use varied widely by FM; there was a greater than fourfold difference in the predicted number of return visits across markets. More nuanced understanding of individual FM characteristics and practices associated with greater return use may help increase program uptake. Third, because proximity between residence and market of first use was strongly correlated with repeat transactions, this work emphasizes the importance of ensuring the accessibility of markets for potential users. Some SNAP incentive programs are now expanding to grocery stores and corner stores,^{28,29} which will likely increase potential reach.

Future research should investigate barriers and facilitators to both first-time and repeat use of SNAP incentive programs. In addition, examining transaction patterns over several years and across multiple cities would augment generalizability. Comparative work across SNAP incentive models is also necessary to examine the effectiveness of different designs (e.g., vouchers, rebates, matches). Finally, additional rigorous evaluation is needed to examine how incentives are spent; if incentives are used in combination with additional forms of payment, such as cash or other food assistance; and the impact of incentives on overall dietary quality and food security.

Limitations

This study has several limitations. First, the data were for a 2-year period from a single city and the majority of transactions were from a single market, which may limit generalizability. The study did, however, include all transactions from all Detroit markets accepting DUFB, allowing for sampling of the entire population of SNAP enrollees using DUFB in Detroit during the study period. Second, although the data allowed for tracking of all EBT transactions, it was not possible to track how or when tokens were spent. Further, because the unit of measurement was number of EBT transactions but tokens could be used over multiple market visits, the number of times individual shoppers visited the FM during the study period may have been underestimated. Third, because the data was limited to transactions at markets in Detroit, it was not possible to assess if any of the study population also used DUFB at non-Detroit FM during the study period. Fourth, it was not possible with this dataset to assess if DUFB users used other forms of payment to supplement their SNAP/DUFB purchases at markets. This may have resulted in underestimation of the amount spent at FM by SNAP enrollees during the study period. Finally, recording or transcription errors may have arisen because of reliance on handwritten transaction logs. However, double-data entry with electronic proofreading was employed. Additionally, transaction data had a 94% match rate with administrative EBT data, and any missing transactions should be missing completely at random.

CONCLUSIONS

In association with the availability of a SNAP incentive program, use of SNAP at Detroit FM in 2012–2013 was far greater than corresponding national rates. Nevertheless, program penetration was limited, and only one third of users had repeat transactions over the 2-year study period. Addressing barriers to initial use and return visits may help maximize the impact of these promising programs on diet quality among Americans at greatest risk of diet-related disease.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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AJ Cohen is responsible for study conception and design, data acquisition, data analysis, data interpretation, and manuscript preparation and revision. She takes responsibility for the integrity of the data and the accuracy of the analyses. LL Lachance contributed to study conception and design, as well as data interpretation. CR Richardson, E Mahmoudi, and JD Buxbaum contributed to data analysis and interpretation. GK Noonan contributed to study design, as well as data linkage and analysis. EC Murphy contributed to data management and data interpretation. DN Roberson contributed to data analysis and interpretation. OB Hesterman contributed to study conception. M Heisler contributed to data analysis and interpretation. SM Zick contributed to study conception and design, as well as data interpretation. All authors provided critical revisions to the manuscript for important intellectual content and approved the final version of the article.

References

- Mabli, J., Ohls, J., Dragoset, L., Castner, L., Santos, B. Measuring the Effect of Supplemental Nutrition Assistance Program (SNAP) Participation on Food Security Food and Nutrition Service. U.S. Department of Agriculture; 2013. <https://fns-prod.azureedge.net/sites/default/files/Measuring2013.pdf>. Accessed September 12, 2017
- Coleman-Jensen, A., Gregory, C., Singh, A. Household Food Security in the United States in 2013. Economic Research Service, U.S. Department of Agriculture; 2014. www.ers.usda.gov/webdocs/publications/45265/48787_err173.pdf?v=42265. Accessed September 12, 2017
- Condon, E., Drilea, S., Jowers, K., Lichtenstein, C., Mabli, J., Niland, K. Diet Quality of Americans by SNAP Participation Status: Data from the National Health and Nutrition Examination Survey, 2007–2010. Food and Nutrition Service, U.S. Department of Agriculture; 2015. www.fns.usda.gov/sites/default/files/ops/NHANES-SNAP07-108.pdf. Accessed September 1, 2017
- Bartlett, S., Klerman, J., Olsho, L., et al. Evaluation of the Healthy Incentives Pilot (HIP) Final Report. U.S. Department of Agriculture, Food and Nutrition Service; 2014. www.fns.usda.gov/ops/research-and-analysis. Accessed September 12, 2017
- Cohen AJ, Richardson CR, Heisler M, et al. Increasing Use of a Healthy Food Incentive: A Waiting Room Intervention Among Low-Income Patients. *Am J Prev Med.* 2017; 52(2):154–162. <https://doi.org/10.1016/j.amepre.2016.11.008>. [PubMed: 28109458]
- Young CR, Aquilante JL, Solomon S, et al. Improving fruit and vegetable consumption among low-income customers at farmers markets: Philly Food Bucks, Philadelphia, Pennsylvania, 2011. *Prev Chronic Dis.* 2013; 10:120356. <https://doi.org/10.5888/pcd10.120356>.
- Savoie-Roskos M, Durward C, Jeweks M, LeBlanc H. Reducing Food Insecurity and Improving Fruit and Vegetable Intake Among Farmers' Market Incentive Program Participants. *J Nutr Educ Behav.* 2016; 48(1):70–76. <https://doi.org/10.1016/j.jneb.2015.10.003>. [PubMed: 26598911]
- Phipps EJ, Braitman LE, Stites SD, et al. Impact of a Rewards-Based Incentive Program on Promoting Fruit and Vegetable Purchases. *Am J Public Health.* 2015; 105(1):166–172. <https://doi.org/10.2105/AJPH.2013.301752>. [PubMed: 24625144]
- Leung CW, Musicus AA, Willett WC, Rimm EB. Improving the Nutritional Impact of the Supplemental Nutrition Assistance Program. *Am J Prev Med.* 2017; 52(2):S193–S198. <https://doi.org/10.1016/j.amepre.2016.07.024>. [PubMed: 28109422]
- Olsho LEW, Klerman JA, Bartlett SH, Logan CW. Rebates to Incentivize Healthy Nutrition Choices in the Supplemental Nutrition Assistance Program. *Am J Prev Med.* 2017; 52(2):S161–S170. <https://doi.org/10.1016/j.amepre.2016.08.023>. [PubMed: 28109418]
- Wilde P, Klerman JA, Olsho LEW, Bartlett S. Explaining the Impact of USDA's Healthy Incentives Pilot on Different Spending Outcomes. *Appl Econ Perspect Policy.* 2016; 38(4):655–672. <https://doi.org/10.1093/aep/ppv028>.

12. Olsho LE, Klerman JA, Wilde PE, Bartlett S. Financial Incentives Increase Fruit and Vegetable Intake Among Supplemental Nutrition Assistance Program Participants: A Randomized Controlled Trial of the USDA Healthy Incentives Pilot. *Am J Clin Nutr.* 2016; 104(2):423–435. <https://doi.org/10.3945/ajcn.115.129320>. [PubMed: 27334234]
13. Agricultural Act of 2014. www.gpo.gov/fdsys/pkg/BILLS-113hr2642enr/pdf/BILLS-113hr2642enr.pdf. Accessed March 5, 2017
14. Fair Food Network. Double Up Food Bucks. www.doubleupfoodbucks.org/. Accessed September 12, 2017
15. Wholesome Wave. Our Network. www.wholesomewave.org/network. Accessed September 12, 2017
16. Food Fair Network. Double Up Food Bucks: A Five-Year Success Story. www.fairfoodnetwork.org/wp-content/image_archive/FFN_DoubleUpFoodBucks_5YearReport.pdf. Accessed March 5, 2017
17. U.S. Census Bureau. American Community Survey 5-Year Estimates: Demographic and Housing Estimates 2011–2015. American Fact Finder. <https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk>. Accessed March 5, 2017
18. Danziger SK, Allard SW, Wathen MV, Michigan RR, Cohen A. Food Insecurity in the Detroit Metropolitan Area Following the Great Recession. *Univ Mich Natl Poverty Cent Policy Brief.* 2014
19. Freedman DA, Mattison-Faye A, Alia K, Guest MA, Hébert JR. Comparing farmers' market revenue trends before and after the implementation of a monetary incentive for recipients of food assistance. *Prev Chronic Dis.* 2014; 11:130347. <https://doi.org/10.5888/pcd11.130347>.
20. Baronberg S, Dunn L, Nonas C, Dannefer R, Sacks R. The Impact of New York City's Health Bucks Program on Electronic Benefit Transfer Spending at Farmers Markets, 2006–2009. *Prev Chronic Dis.* 2013; 10:130113. <https://doi.org/10.5888/pcd10.130113>.
21. Choi SE, Seligman H, Basu S. Cost Effectiveness of Subsidizing Fruit and Vegetable Purchases Through the Supplemental Nutrition Assistance Program. *Am J Prev Med.* 2017; 52(5):e147–e155. <https://doi.org/10.1016/j.amepre.2016.12.013>. [PubMed: 28153648]
22. SmartyStreets. Address Verification, Validation, and Autocomplete. <https://smartystreets.com/>. Accessed March 11, 2017
23. Institute for Digital Research and Education, University of California, Los Angeles. Negative Binomial Regression | Stata Data Analysis Examples. <http://stats.idre.ucla.edu/stata/dae/negative-binomial-regression/>. Accessed March 5, 2017
24. Food and Nutrition Service, U.S. Department of Agriculture. SNAP Retailer Management 2013 Annual Report. FNS; 2014. www.fns.usda.gov/sites/default/files/snap/2013-annual-report.pdf. Accessed March 5, 2017
25. Farson Gray, K., Kochha, S. Characteristics of Supplemental Nutrition Assistance Program Households: Fiscal Year 2014. Office of Policy Support, Food and Nutrition Service, U.S. Department of Agriculture; 2015. www.fns.usda.gov/sites/default/files/ops/Characteristics2014.pdf. Accessed March 5, 2017
26. Olsho LE, Payne GH, Walker DK, Baronberg S, Jernigan J, Abrami A. Impacts of a Farmers' Market Incentive Programme on Fruit and Vegetable Access, Purchase and Consumption. *Public Health Nutr.* 2015; 18(15):2712–2721. <https://doi.org/10.1017/S1368980015001056>. [PubMed: 25919225]
27. Freedman DA, Choi SK, Hurley T, Anadu E, Hébert JR. A Farmers' Market at a Federally Qualified Health Center Improves Fruit and Vegetable Intake Among Low-Income Diabetics. *Prev Med.* 2013; 56(5):288–292. <https://doi.org/10.1016/j.ypmed.2013.01.018>. [PubMed: 23384473]
28. Fair Food Network. Double Up Food Bucks: How It Works at Grocery Stores. www.doubleupfoodbucks.org/how-it-works/grocery-stores/. Accessed September 12, 2017
29. Wholesome Wave. Doubling SNAP. www.wholesomewave.org/how-we-work/doubling-snap. Accessed September 12, 2017

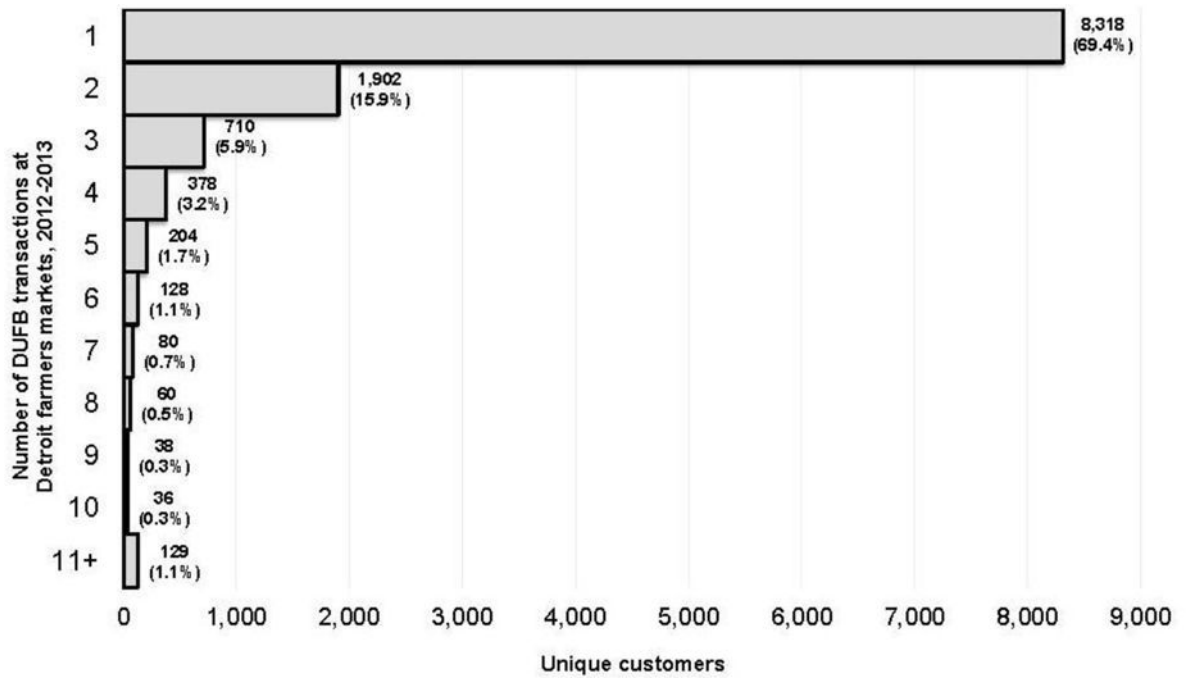


Figure 1. Number of Double Up Food Bucks (DUF) transactions per unique customer.

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Table 1

Characteristics of Double Up Food Bucks (DUFB) Users at Detroit Farmers Markets and Overall Detroit SNAP-Enrolled Population

Characteristics	DUFB users at Detroit farmers markets, 2012–2013 ^{a,b}			Detroit SNAP enrolled population, 2013 ^c (n=149,338)
	Total (n=11,983)	Living outside Detroit (n=4,167)	Living in Detroit (n=7,816)	
Female, % (N)	71.7 (8,586)	74.3 (3,097)	70.2 (5,488)	55.8
Race/Ethnicity, % (N)				
Non-Hispanic black	73.8 (8,837)	51.9 (2,164)	85.4 (6,672)	84.1
Non-Hispanic white	18.0 (2,154)	38.3 (1,595)	7.2 (559)	9.4
Hispanic/Latino	1.6 (193)	1.7 (70)	1.6 (123)	2.3
Other	1.3 (158)	2.6 (109)	0.6 (49)	0.4
Missing	5.4 (641)	5.5 (228)	5.3 (413)	3.5
Age, years, mean (SD)	43.8 (14.5)	41.4 (13.7)	45.1 (14.8)	–
Marital status, % (N)				
Single, never married	36.1 (4,329)	32.7 (1,364)	37.9 (2,964)	42.0
Married	5.6 (669)	9.2 (383)	3.7 (286)	3.4
Divorced/separated/widowed	10.8 (1,289)	13.1 (547)	9.5 (742)	6.7
Missing/unknown ^d	47.5 (5,696)	44.9 (1,872)	48.9 (3,824)	47.9
Households with 1 eligible adult, % (N)	83.1 (9,958)	78.3 (3,260)	85.7 (6,697)	90.4
Households with 1 child under age 18 years, % (N)	42.3 (5,070)	48.9 (2,036)	38.8 (3,033)	44.1
Home Residence, % (N)				
City of Detroit	65.2 (7,816)	–	100.0 (7,816)	100.0 (149,338)
Metro Detroit ^e (not including City of Detroit)	30.9 (3,702)	88.8 (3,702)	–	–
Michigan, outside of Metro Detroit	3.2 (379)	9.1 (379)	–	–
State other than Michigan	0.7 (86)	2.1 (86)	–	–
Households reporting zero gross annual income, % (N)	30.4 (3,642)	28.7 (1,196)	31.3 (2,444)	–
Gross annual income of households reporting income greater than zero, median(IQR)	\$8,856 (\$6,864–\$12,972)	\$9,444 (\$6,864–\$15,060)	\$8,784 (\$6,864–\$11,988)	–
Households <100% FPL, % (N)	87.2 (10,444)	85.1 (3,544)	88.3 (6,899)	62.4 ± 1.3% ^f
Months eligible for SNAP, median (IQR)				
2012–2013 (Full 24 month period)	20 (16–21)	19 (15–21)	20 (17–21)	–
2012–2013 (10 months during which DUFB available)	10 (7–10)	10 (6–10)	10 (8–10)	–
SNAP assistance/month, median (IQR)	\$200 (\$200–\$412)	\$227 (\$200–\$477)	\$200 (\$200–\$367)	–
SNAP/DUFB transactions, median (IQR)				

Characteristics	DUFB users at Detroit farmers markets, 2012–2013 ^{a,b}			Detroit SNAP enrolled population, 2013 ^c (n=149,338)
	Total (n=11,983)	Living outside Detroit (n=4,167)	Living in Detroit (n=7,816)	
Average SNAP redeemed per purchase	\$20 (\$10–\$20)	\$20 (\$12–\$23)	\$20 (\$10–\$20)	–
Average DUFB matched per purchase	\$20 (\$10–\$20)	\$20 (\$12–\$20)	\$17 (\$10–\$20)	–
Total SNAP redeemed per user (2012–2013 DUFB season)	\$20 (\$10–\$40)	\$20 (\$15–\$40)	\$20 (\$10–\$38)	–
Total DUFB matched per user (2012–2013 DUFB season)	\$20 (\$10–\$22)	\$20 (\$14–\$26)	\$20 (\$10–\$20)	–
Distance to farmers market of first transaction, median (IQR)	8.7 (4.2–14.2)	16.1 (10.5–22.5)	6.5 (2.9–9.8)	–
0–1 mile, N (%)	686 (5.7)	3 (0.1)	683 (8.7)	–
>1–5 miles	2,705 (22.6)	189 (4.5)	2,516 (32.2)	–
>5–10 miles	3,479 (29.0)	700 (16.8)	2,779 (35.6)	–
>10–15 miles	2,369 (19.8)	879 (21.1)	1,490 (19.1)	–
>15 miles	2,744 (22.9)	2,395 (57.5)	349 (4.5)	–
Households receiving other financial assistance, ^g % (N)				
TANF	12.7 (1,468)	10.7 (444)	13.5 (1,023)	–
Medicaid	75.4 (8,741)	71.6 (2,981)	76.1 (5,760)	–
State disability assistance	2.2 (249)	1.7 (72)	2.3 (177)	–
State emergency relief	31.4 (3,641)	28.2 (1,175)	32.6 (2,466)	–

^aAll Double Up Food Bucks users are SNAP-enrolled

^b2012 DUFB season June–November, 2013 DUFB season July–October 2013

^cPoint prevalence of SNAP enrollees on December 31, 2013, from SNAP administrative data

^dMarital status labeled as optional category on SNAP enrollment forms, resulting in large amount of missing unknown

^eOakland, Wayne, and Macomb counties (not including City of Detroit)

^fU.S. Census Bureau, 2011–2013 American Community Survey

^gReceived at least once during 24-month study period

SNAP, Supplemental Nutrition Assistance Program; DUFB, Double Up Food Bucks; FPL, Federal Poverty Level; TANF, Temporary Assistance for Needy Families; IQR, Interquartile Range

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Table 2
 Characteristics of Detroit Farmers Markets Accepting Double Up Food Bucks (DUFb) in 2013

Market	Number of vendors	Hours	2013 season	Average number of shoppers per day	Years accepting DUFb
Eastern Market	Tuesday 50 Saturday 250	Tuesday 9AM–3PM Saturday 6AM–4PM	Tuesday July 9–October 29 Saturday year round	Tuesday 3,000 Saturday 30,000–40,000	4
Wayne State	12–16	Wednesday 11AM–4PM	June 5–October 30	900	4
Northwest Detroit	15–18	Thursday 4PM–8PM	June 6–October 10	260	4
Peaches & Greens	Produce store	Tuesday–Friday 10AM–7PM Saturday 10AM–3PM	Year round	85	4
Eastside Market	8–12	Friday 3PM–7PM	June 7–September 27	130	4
Sowing Seeds Growing Futures	8–10	Tuesday 3PM–7PM	June 4–October 15	75	3
Oakland Ave	3–5	Saturday 11AM–3:30PM	June 1–October 12	30	2
Meldrum Fresh	1	Thursday 11AM–2PM	May 16–November 15	18	1

Table 3

Correlates of Repeat Transactions Among Double Up Food Bucks (DUFB) Users at Detroit Farmers Markets, 2012–2013

Characteristics	Incident rate ratio	95% CI	Predicted number of repeat transaction	p-value
Gender				
Female	ref		0.90	
Male	0.96	0.87, 1.06	0.77	0.399
Race/Ethnicity				
Black, non-Hispanic	ref		0.66	
White, non-Hispanic	2.34	2.11, 2.59	1.38	<0.001
Hispanic	1.30	0.94, 1.79	0.80	0.110
Other	2.00	1.45, 2.77	1.24	<0.001
Age, years	1.01	1.00, 1.03	<i>_a</i>	0.142
Children				
No children in home	ref		0.91	
At least one child aged <18 years in home	0.95	0.82, 1.09	0.68	0.430
Income-to-poverty ratio	1.02	0.92, 1.14	<i>_a</i>	0.687
Average monthly SNAP benefit	1.00	1.00, 1.00	<i>_a</i>	0.225
Months receiving SNAP during 2012–2013 DUFB season	1.01	0.99, 1.03	<i>_a</i>	0.186
Assistance programs ^b				
Medicaid	0.82	0.74, 0.91	0.76	<0.001
State emergency relief	0.99	0.90, 1.09	0.81	0.862
State disability assistance	0.87	0.65, 1.19	0.71	0.388
Market of first transaction				
Eastern Market	ref		0.77	
Wayne State Farmers Market	1.80	1.48, 2.18	1.39	<0.001
Northwest Detroit Farmers Market	0.98	0.80, 1.19	0.75	0.804
Eastside Farmers Market	0.36	0.24, 0.55	0.28	<0.001
Peaches and Greens	1.38	1.18, 1.61	1.06	<0.001
Meldrum Fresh Market	1.58	0.66, 3.78	1.22	0.306
Sowing Seeds Growing Futures	0.41	0.26, 0.66	0.32	<0.001
Oakland Avenue Farmers Market	0.90	0.54, 1.48	0.69	0.667
Distance from residence to market of first transaction ^c				
1 mile			0.94	
5 miles			0.88	
10 miles			0.81	
15 miles			0.75	

Notes: Negative binomial regression, adjusted for month and year of first transaction. Boldface indicates statistical significance ($p < 0.05$).

^aFor continuous variables that were nonsignificant in the model, predicted number of visits not calculated.

^bReceipt of Medicaid, State emergency relief, and/or State disability assistance at least once during study period.

^cRoad miles from residential nine-digit ZIP code to market of first transaction.

SNAP, Supplemental Nutrition Assistance Program

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