Journal of Agriculture, Food Systems, and Community Development
ISSN: 2152-0801 online
https://foodsystemsjournal.org

# Association between nutrition assistance programs and household produce waste during the COVID-19 pandemic

Akiko S. Hosler,[a] * Heather A. Duncan,[b] Beth J. Feingold,[c] Xiaobo X. Romeiko,[d] Christine T. Bozlak [e]
University at Albany

Jiacheng Chen [f]
Centre Hospitalier Universitaire (CHU) Sainte-Justine

Mariana Torres Koutsopoulos [g]
American University

Tianghon Mu [h]
North Carolina Agricultural and Technical State University

Submitted January 17, 2026 / Revised April 14 and June 2, 2026 / Accepted June 4, 2026 / Published online September 22, 2026

Citation: Hosler, A. S., Duncan, H. A., Feingold, B. J., Romeiko, X. X., Bozlak, C. T., Chen, J., Koutsopoulos, M. T., & Mu, T. (2026). Association between nutrition assistance programs and household produce waste during the COVID-19 pandemic. *Journal of Agriculture, Food Systems, and Community Development.* Advance online publication. https://doi.org/10.5304/jafscd.2026.154.027



## Abstract

Fresh produce is the most wasted food, accounting for about 45% of household food waste in the United States. The literature is inconclusive about whether nutrition assistance programs aimed at increasing access to healthy food affect household food waste, particularly during the COVID-19 pandemic. To address this knowledge gap, we investigated the association between participation in nutrition assistance programs (food pantries and the Supplemental Nutrition Assistance Program, or SNAP) and changes in household produce waste since the beginning of the COVID-19 pandemic. Given that more fresh produce was distributed to

[a] * *Corresponding author:* Akiko S. Hosler, Associate Professor, Department of Epidemiology and Biostatistics, University at Albany College of Integrated Health Sciences, 1400 Washington Avenue, Albany, New York, 12222, USA; +1-518-698-1629; ahousler@albany.edu; https://orcid.org/0000-0003-0642-1060

[b] Heather A. Duncan, Doctoral Student, Department of Epidemiology and Biostatistics, University at Albany College of Integrated Health Sciences, 1400 Washington Avenue, Albany, New York, 12222, USA; haduncan@albany.edu; https://orcid.org/0009-0007-9404-9911

[c] Beth J. Feingold, Associate Professor, Department of Environmental Health Sciences, University at Albany College of Integrated Health Sciences, 1400 Washington Avenue, Albany, New York, 12222, USA; bfeingold@albany.edu; https://orcid.org/0000-0001-6670-5845

[d] Xiaobo X. Romeiko, Associate Professor, Department of Environmental Health Sciences, University at Albany College of Integrated Health Sciences, 1400 Washington Avenue, Albany, New York, 12222, USA; xxue@albany.edu; https://orcid.org/0000-0001-5579-2111

*More author bios and disclosures are on the next page.*

food pantries during the pandemic, we examined whether the perceived quality of fresh produce at food pantries may influence household food waste behavior. We conducted an online survey for adults residing in the Capital Region of New York state from October to December 2021. Among 504 respondents, 27% reported throwing away less produce than usual since the COVID-19 pandemic began, 22% used food pantries, and about half perceived the quality of fresh produce at those pantries as poor. Approximately one-third of respondents were SNAP participants, including the Pandemic Electronic Benefit Transfer (P-EBT). We found that food pantry users who rated produce quality as acceptable had 2.4 times the odds of wasting less produce since the COVID-19 pandemic began compared to non-users of food pantries. Similarly, SNAP/P-EBT users were more likely to report less household produce waste compared to non-SNAP/P-EBT users. Our findings highlight that participation in food assistance programs may help reduce household food waste and underscore the importance of maintaining fresh produce quality at a level clients perceive as acceptable. We suggest greater collaboration among public health nutrition, food waste research, and food systems stakeholders to work toward the common goals of efficiently distributing healthy food, reducing food waste, and eliminating hunger.

**Keywords**
household food waste, fresh produce, fruit and vegetables, COVID-19, pandemic, food pantries, SNAP, perceived food quality, nutrition assistance program, New York State

## Introduction

In the U.S., over one-third of the food produced is never eaten (U.S. Environmental Protection Agency [US EPA], 2023a). Food waste occurs at various stages of the food's life cycle. According to the US EPA, the largest share of food waste is generated by the food retail, food service, and residential sectors, with approximately 40% coming from individual households (2023b). The literature confirms that food wasted at the final consumption stage is the most significant source of food loss (Bellemare et al., 2017; Buzby et al., 2014; Yu & Jaenicke, 2020). Furthermore, fresh produce is the most wasted food in U.S. households. A ReFED (2025) study indicated that in 2024, fresh produce accounted for 45.2% of household food waste, three times the amount of the second-most-wasted food, dry goods (14.9%). A 2023 survey of 9,259 American consumers found that vegetables were the most-wasted food group, with an average of 1.3 cups wasted per week, closely followed by fruits, with 1.2 cups wasted per week (MITRE & Gallup, 2023).

For several decades, the U.S. public health community has focused on promoting fruit and vegetable consumption. Most Americans, particularly low-income and food-insecure individuals, are not meeting the recommended levels of fruit and vegetable intake, putting them at risk of various nu-

[e] Christine T. Bozlak, Associate Professor, Department of Health Policy, Management and Behavior, University at Albany College of Integrated Health Sciences, 1400 Washington Avenue, Albany, New York, 12222, USA; cbozlak@albany.edu; https://orcid.org/0000-0002-6057-0457

[f] Jiacheng Chen, Postdoctoral Fellow, the Centre Hospitalier Universitaire (CHU) Sainte-Justine, 3175 Chem. de la Côte-Sainte-Catherine, Montréal, QC H3T 1C5, Canada; jiacheng.chen.1@umontreal.ca; https://orcid.org/0000-0002-2702-0728

[g] Mariana Torres Koutsopoulos, Research Fellow, Department of Environmental Science, American University, Hall of Science, 4400 Massachusetts Avenue NW, Washington, DC 20016, USA; marianak@american.edu; https://orcid.org/0000-0001-5188-0149

[h] Tianghon Mu, Research Associate, Department of Natural Resources and Environmental Design, North Carolina Agricultural and Technical State University, 1601 E Market St, Sockwell Hall Room 113, Greensboro, NC 27411, USA; tmu@ncat.edu; https://orcid.org/0000-0002-2868-2643

**Disclosures**
All authors declare no conflicts of interest.

**Funding Disclosures**
This work was funded by the Foundation for Food and Agriculture Research's COVID-19 Supplemental Funding, the University at Albany President's COVID-19 Minority Health Disparities Engaged Researchers Seed Funding Program, and the New York State Governor's Office's Differential Impacts of COVID-19 in New York State Grant.

trition-related diseases (2025 Dietary Guidelines Advisory Committee, 2024; Havas et al., 1994; Lee et al., 2022). High costs, limited access to grocery stores, and perceived constraints on convenience are major barriers to low-income individuals' regular consumption of fresh fruits and vegetables (Haynes-Maslow et al., 2015). Nutrition safety-net programs, such as the Supplemental Nutrition Assistance Program (SNAP) and food pantries, play an integral role in increasing access to fresh produce, promoting its consumption, and reducing hunger (Eicher-Miller, 2020; Engel & Ruder, 2020). However, little is known about how much food from nutrition assistance programs is wasted at home. Some studies demonstrate that low-income and food-insecure households waste less food (Daniel, 2016; Ghafoorifard et al., 2022; Yu & Jaenicke, 2020), while other studies report no associations between income level and food waste, suggesting that food waste behavior is complex and cannot be explained by a single factor (Schanes et al., 2018).

The COVID-19 pandemic introduced additional challenges for nutrition assistance programs. Due to disruptions in the food supply chain and employment, the number of food-insecure households increased significantly across the U.S. (Niles et al., 2021; Pryor & Dietz, 2022). To combat this phenomenon, SNAP expanded eligibility and benefits (Restrepo, 2023), and food pantries increased the collection of fresh produce through their own networks and special government programs (Huang et al., 2023; Larison et al., 2021; Winkler et al., 2023). As a result, more fresh produce was collected and distributed than usual (Huang et al., 2023; Larison et al., 2021). Studies reported that utilization of nutrition assistance programs was associated with increased fruit and vegetable consumption during the pandemic (Bertmann et al., 2021; Lee et al., 2023; Woo Baidal et al., 2024). However, researchers also note that the increased availability of fresh produce can lead to greater household food waste, particularly when the produce clients receive is of poor quality or otherwise undesirable (Kihlstrom et al., 2019; Pruden et al., 2020). Did participation in nutrition assistance programs affect household produce waste during the COVID-19 pandemic? To answer this question, we analyzed survey data collected in the last quarter of 2021 to investigate the association between participation in nutrition assistance programs and changes in household produce waste since the onset of the COVID-19 pandemic. We incorporated the perceived quality of fresh produce at food pantries in the analysis. Findings from this study can help public health professionals better understand the levers of household food waste and, in turn, safeguard fruit and vegetable consumption and reduce hunger during the pandemic.

## Data Source

We used the COVID-19 Food Access Survey III (FAS3), which aimed to understand and track adults' experiences, attitudes, perceptions, and needs related to food security and access. We adapted the questionnaire developed by the National Food Access and COVID research Team (NFACT), a consortium that assessed COVID-related food access across multiple U.S. study sites (Niles et al., 2021). The study community was the Capital Region of New York state. This region is home to 1.24 million people living throughout 11 counties and includes the Albany-Schenectady-Troy Metropolitan Statistical Area. During the first 10 months of the COVID-19 pandemic, 40% of residents in this region reported experiencing food insecurity at some point (Feingold et al., 2021). We administered FAS3 via a Qualtrics online panel from October 20, 2021, to December 13, 2021, or approximately 19 to 21 months since the beginning of the COVID-19 outbreak. The eligibility criteria were adults aged 18 or older who lived in the study region and who were able to consent and take a self-administered survey in English or Spanish. Qualtrics sent the sociodemographic screener to potential participants to ensure half of the respondents were from low-income households (i.e., annual household income less than $50,000[1]). As an incentive, participants received "points" based on the length and complexity of the Qualtrics survey, which they could redeem for monetary rewards later.

[1] All currency in this article is in U.S. dollars.

## Measures

The outcome of interest is whether less fresh produce was wasted at the household level since the beginning of the COVID-19 pandemic. The binary variable ("Yes" for wasted less fresh produce) was derived from the question "Has your household done any of the following in the past year?" and the response option "Throw away less fresh produce than normal." The exposure variables were self-reported household participation in the food pantry and in SNAP during the COVID-19 pandemic. To incorporate the perceived quality of the food pantry's produce into the food pantry variable, we examined how food pantry users had responded to the statement "the food pantry has good quality of fruits and vegetables" in the section on their experience of food pantry usage in the past year. Those who strongly disagreed or disagreed with this item were considered to have rated the quality of fresh produce as "poor," while those who strongly agreed, agreed, or had no opinion were considered to have rated it as "acceptable." We then created a three-category variable to indicate whether respondents were food pantry users who rated the quality of fresh produce as poor or acceptable, or were non-users of food pantries. The SNAP variable was binary; "Yes" indicated SNAP or Pandemic Electronic Benefit Transfer (P-EBT) enrollment.

Additionally, we measured changes in fruit and vegetable consumption and cooking behavior because the literature suggests these behaviors are related to food waste (Ghafoorifard et al., 2022; Grier-Welch et al., 2021; Rodgers et al., 2021). The fruit and vegetable consumption variable was derived from a question asking respondents whether they have been eating more, less, or about the same amounts of fresh fruits and vegetables per day since the COVID-19 pandemic began. Similarly, the cooking variable assessed whether the respondent spent more time cooking than prior to the COVID-19 pandemic. We assessed the following sociodemographic characteristics as potential covariates: age (18–34, 35–54, and 55+), gender (male, female, and other), race/ethnicity (Hispanic, Non-Hispanic White, Non-Hispanic Black, and other or multiple), annual household income (less than $10,000, $10,000–24,999, $25,000–49,999, $50,000–74,999, $75,000–99,999, and $100,000+), educational attainment (high school or less, some college, or college degree or higher), and political affiliation (liberal, moderate, conservative, or don't know/prefer not to answer) .

## Data Analysis

First, we conducted descriptive analyses of all the variables to be included in the model and evaluated their distributions, intercorrelations, and associations with the outcome variable. To provide additional context on the sample, we also conducted descriptive analysis of a subset of food pantry users' characteristics. Next, we conducted a logistic regression analysis of the outcome, with higher odds ratios (ORs) indicating a greater likelihood of reporting that they were wasting less fresh produce than usual since the COVID-19 pandemic began. After we constructed the baseline model, which included all exposure variables and covariates described earlier, we identified the final model using a stepwise backward-elimination approach. At each step, we removed the variable with the largest Wald test p-value, then performed a likelihood ratio test (LRT) to confirm that its removal did not significantly worsen model fit. Variables were dropped if the LRT p-value exceeded 0.05, and this process was repeated until all remaining variables met the retention threshold. We assessed the final model's fit and sensitivity using the Hosmer-Lemeshow test and evaluated its discriminative ability using the C-statistic (Hosmer et al., 1991). We also made some adjustments to certain variables to facilitate ease of interpretation. The fruit and vegetable consumption variable was initially coded as a three-category variable with levels "less," "same," and "more." When "same" was the reference level, the OR for "less" was close to 1.00 and did not alter significantly after adjustment. Therefore, we coded this variable as binary, with "less/same" and "more." We excluded income from the model due to high multicollinearity with the SNAP variable. We completed all analyses using SAS Studio OnDemand.

## Results

There were 504 respondents in the analysis dataset. Table 1 summarizes the results of the descriptive analysis. Twenty-seven percent (27.0%) of re-

**Table 1. Characteristics of the FAS3 Participants (*N* = 504)**

| Characteristic | *N* | % |
|---|---|---|
| **Throwing away less produce** | | |
| Yes | 136 | 27.0 |
| No | 368 | 73.0 |
| **Food pantry use and produce quality** | | |
| Produce quality at food pantry is poor | 58 | 11.5 |
| Produce quality at food pantry is acceptable | 55 | 10.9 |
| Do not use a food pantry | 391 | 77.6 |
| **SNAP/P-EBT user** | | |
| Yes | 147 | 29.2 |
| No | 357 | 70.8 |
| **Spending more time cooking** | | |
| Yes | 283 | 56.2 |
| No | 221 | 43.8 |
| **Eating more fruits and vegetables** | | |
| Yes | 70 | 13.9 |
| No | 424 | 84.1 |
| Unknown | 10 | 2.0 |
| **Age** | | |
| 18–34 | 168 | 33.3 |
| 35–54 | 158 | 31.4 |
| 55+ | 178 | 35.3 |
| **Gender** | | |
| Male | 131 | 26.0 |
| Female | 364 | 72.2 |
| Other | 9 | 1.8 |
| **Race/Ethnicity** | | |
| Hispanic | 40 | 7.9 |
| Non-Hispanic White | 380 | 75.4 |
| Non-Hispanic Black | 48 | 9.5 |
| Other/Multiple | 36 | 7.1 |
| **Household Income** | | |
| Less than $10,000 | 43 | 8.5 |
| $10,000–24,999 | 68 | 13.5 |
| $25,000–49,999 | 146 | 29.0 |
| $50,000–74,999 | 95 | 18.9 |
| $75,000–99,999 | 61 | 12.1 |
| $100,000+ | 91 | 18.1 |
| **Education** | | |
| High school or less | 146 | 29.0 |
| Some college | 194 | 38.5 |
| College degree or higher | 164 | 32.5 |
| **Political Affiliation** | | |
| Liberal | 129 | 25.6 |
| Moderate | 168 | 33.3 |
| Conservative | 110 | 21.8 |
| Don't know or prefer not to say | 97 | 19.3 |

spondents reported throwing away less fresh produce since the COVID-19 pandemic began, and 22.4% of respondents used food pantries. Out of 113 food pantry users 58 (51.3%) perceived the quality of fresh produce at food pantries as poor. Approximately one-third of respondents (29.2%) were SNAP or P-EBT participants. While more than half of all respondents (56.2%) reported cooking more frequently, only 13.9% reported eating more fruits and vegetables. In terms of sociodemographic characteristics, women, adults aged 35 to 54, low-income individuals, and people of Hispanic and non-Hispanic Black race/ethnicity were overrepresented relative to the Capital Region's overall population (New York State Department of Labor, 2026).

Table 2 describes characteristics of food pantry users ($n$ = 113). Typical food pantry users were those who became clients after the COVID-19 pandemic began (55.8%) and used one or two different food pantries (75.0%), with visits occurring once a month or less (62.2%). A majority (71.4%) consumed at least 75% of the fruits and vegetables they obtained from food pantries, with a mean consumption of 81.9%. They reported that it took an average of 3.8 days for fruits and vegetables from the food pantry to go bad.

Table 3 presents the results of the baseline and final logistic regression models for wasting less produce since the COVID-19 pandemic began ($n$ = 494). None of the sociodemographic variables, except for the 35–54 age group, was significantly associated with the outcome variable. In the final model, food pantry users who rated produce quality as acceptable had 2.38 times the odds of wasting less produce compared with non-users of food pantries (95% CI, 1.14–4.92). SNAP/P-EBT participation (OR 1.88, 95% CI 1.16–3.28), increased cooking frequency (OR 5.79, 95% CI 3.49–9.97), increased fresh fruit and vegetable intake (OR 2.20, 95% CI 1.23–3.93), and the 35–54 age group (OR 1.81, 95% CI 1.05–3.15) were also significantly associated with wasting less produce compared to their respective reference groups. The Hosmer-Lemeshow test indicates a good model fit (p=0.7593), and the c-statistic indicates an acceptable model fit (c=0.763) (data not shown).

## Discussion

Our motivation for conducting this study was to investigate whether participation in existing nutrition assistance programs during the COVID-19 pandemic had a positive or negative impact on household food waste. Through analysis of FAS3, a survey conducted in New York state's Capital Region in the last quarter of 2021, we found that since the COVID-19 pandemic, food pantry users who perceived the quality of fresh produce as acceptable were significantly more likely to report less produce waste than usual compared to non-users of food pantries. Similarly, SNAP/P-EBT participants were more likely to report less produce waste compared with non-SNAP/EBT participants. These are encouraging findings for both the public health and environmental science communities. Approximately 60% of household food waste is landfilled; therefore, any measures that reduce household food waste can potentially lessen soil and water contamination and reduce methane and carbon dioxide emissions (US EPA, 2023b).

**Table 2. Characteristics of FAS3 Food Pantry Users (*n* = 113, % is for valid cases only)**

| Characteristic | *n* | % |
|---|---|---|
| **Food pantry use history** | | |
| Start using it before the COVID-19 pandemic | 50 | 44.2 |
| Start using it since the COVID-19 pandemic | 63 | 55.8 |
| **Number of different food pantries used** | | |
| One | 56 | 50.0 |
| Two | 28 | 25.0 |
| Three | 18 | 16.1 |
| Four | 10 | 8.9 |
| **Frequency of food pantry use** | | |
| Once a month or less | 69 | 62.2 |
| 2–3 times a month | 28 | 25.2 |
| Once a week or more | 14 | 12.6 |
| **Percent of fruit and vegetables from food pantries that are eaten** [a] | | |
| 0–49% | 5 | 4.8 |
| 50–74% | 25 | 23.8 |
| 75–99% | 50 | 47.6 |
| 100% | 25 | 23.8 |
| **Number of days before pantry fruits and vegetables went bad** [b] | | |
| 0 day (already bad) | 11 | 15.3 |
| 1 day | 6 | 8.3 |
| 2 days | 11 | 15.3 |
| 3 days | 14 | 19.4 |
| 4 days | 10 | 13.9 |
| 5 days or more | 20 | 27.8 |

[a] The mean is 81.9% with a standard deviation of 18.9%.
[b] The mean is 3.8 days with a standard deviation of 4.4 days

### *Food Pantry Implications*

For food pantries, our findings highlight the importance of maintaining the quality of fresh produce at the level their clients perceive as acceptable. Food pantry clients desire higher-quality food, including nutritious items and food that is not close to expiration (Long et al., 2023). A food item not being "good enough" in consumers' assessment has been identified as the primary reason for food waste (Aschemann-Witzel et al., 2019). During the pandemic, the New York State government implemented "Nourish New York," a program to redistribute surplus fresh produce and other farm products to food pantries (New York State Department of Agriculture and Markets, n.d.). The program increased the volume of donated fresh produce; however, it is very likely that some food pantries were not fully prepared to keep them in good quality, mainly due to staff/volunteer shortage and a lack of refrigeration equipment and cold storage (Huang et al., 2023; Wetherill et al., 2019; Winkler et al., 2023). In our study, slightly more than half of food pantry clients rated their food pantry's fresh produce as "poor quality," and nearly a quarter of clients reported that fresh produce went bad within a day. It is also noteworthy that most food pantries in the study area operated with the client-choice model before the pandemic (Winkler et al., 2023). However, public health measures to reduce community transmission of COVID-19 forced food pantries to switch to the fixed-bundle model (also known as the prepackaged-bag model) (Larison et al., 2021; Winkler et al., 2023). The fixed-bundle model has been associated with greater household

food waste (Pruden et al., 2020). Despite reduced client choices, our study provides evidence that food pantries can help reduce produce waste, provided they maintain fresh produce quality at or above acceptable levels.

**Table 3. Results of the Logistic Regression Analysis for Throwing Away Less Produce Since the COVID-19 Pandemic: FAS3 data (*N* = 494)**

| Variable | Baseline Model OR95% CI | Final Model OR95% CI |
|---|---|---|
| **Food pantry produce quality** | | |
| Produce quality at food pantry is poor | 1.960.99–3.91 | 1.960.99–3.92 |
| Produce quality at food pantry is acceptable | 2.241.06–4.74 | 2.381.14–4.92 |
| Do not use a food pantry | 1.00REF | 1.00REF |
| **SNAP User** | | |
| Yes | 1.721.00–2.96 | 1.881.16–3.28 |
| No | 1.00REF | 1.00REF |
| **Spending more time cooking** | | |
| Yes | 6.263.65–10.72 | 5.793.49–9.97 |
| No | 1.00REF | 1.00REF |
| **Eating more fruits and vegetables** | | |
| Yes | 2.261.26–4.06 | 2.201.23–3.93 |
| No | 1.00REF | 1.00REF |
| **Age** | | |
| 18–34 | 1.00REF | 1.00REF |
| 35–54 | 1.961.10–3.51 | 1.811.05–3.15 |
| 55+ | 1.630.87–3.05 | 1.550.86–2.66 |
| **Gender** | | |
| Male | 1.00REF | |
| Female | 0.930.53–1.62 | |
| Other | 0.520.07–3.67 | |
| **Race/Ethnicity** | | |
| Hispanic | 1.00REF | |
| Non-Hispanic White | 1.130.49–2.63 | |
| Non-Hispanic Black | 1.470.52–4.16 | |
| Other/Multiple | 1.390.45–4.27 | |
| **Education** | | |
| High school or less | 1.00REF | |
| Some college | 0.830.48–1.46 | |
| College degree or higher | 0.620.33–1.19 | |
| **Political Affiliation** | | |
| Liberal | 1.00REF | |
| Moderate | 1.080.6–1.97 | |
| Conservative | 0.800.4–1.59 | |
| Don't know or prefer not to say | 1.030.51–2.09 | |

OR: Odds Ratio, CI: Confidence Interval, REF: Referent

### *SNAP Implications*

Literature that focuses on SNAP and household food waste is limited and inconsistent. A study that employed mathematical models estimated that SNAP would substantially increase food purchases, leading to greater food waste (Yu & Fan, 2023). In contrast, another study that used a different modeling technique estimated that SNAP would significantly reduce household food waste (Yu & Jaenicke, 2020). These existing studies used pre-pandemic data and did not factor in the expansion of SNAP during the pandemic, which enrolled more higher-income individuals and provided greater benefits (Restrepo, 2023). Moreover, New York state was one of five states that introduced an online SNAP food purchase program before the COVID-19 pandemic and continued it during the pandemic (Kinsey et al., 2020). Our study's association between SNAP/P-EBT and reduced produce waste might have been influenced by pandemic-specific SNAP provisions that enabled participants to purchase desirable, high-quality fresh produce. In addition, our study's findings on the relationships between increased fruit and vegetable consumption, increased home cooking, and less food waste are consistent with the literature (Ghafoorifard et al., 2022; Grier-Welch et al., 2021; Rodgers et al., 2021).

### *Strengths and Limitations*

This study has several strengths. The dataset included approximately 500 respondents, with oversampling of low-income individuals, enabling us to conduct analyses with adequate statistical

power and adjust for sociodemographic covariates. The questionnaire we used was pilot-tested, and its key construct domains had reasonably high internal validity (Niles et al., 2021). The outcome and some independent variables were assessed retrospectively; thus, we were able to account for temporality in the analysis. Finally, this study is among the few that directly evaluated the association between nutrition assistance programs and household food waste.

This study also has limitations. The oversampling of low-income individuals limits the generalizability of the results to the study population. FAS3 was administered online via Qualtrics, which may have limited participation among those without digital literacy skills or regular internet access. Those without regular internet access tend to be older, less educated, rural adults (Hargittai et al., 2019). All behavioral variables used in this study were based on self-report and may be subject to recall and social desirability biases (Fadnes et al., 2008). Moreover, these variables were relative measures (e.g., less or more, increased or decreased), and no absolute quantities, volumes, or frequencies were obtained. Nonetheless, these measures were obtained with minimal respondent burden and are appropriate for an exploratory study.

## Conclusion

In conclusion, this study suggests that nutrition assistance programs during the COVID-19 pandemic may have led to beneficial outcomes despite increased food insecurity: they not only swiftly expanded access to fresh fruit and vegetables but also likely reduced household waste of these items among participants. For food pantries, this was achieved when the fresh produce provided was of acceptable quality to their clients. Improving the quality of fresh produce in food pantries remains an ongoing issue that requires attention. Several studies provide valuable "lessons learned" and insights about this subject (Huang et al., 2023; Larison et al., 2021; Long et al., 2023; Pruden et al., 2020; Wetherill et al., 2019; Winkler et al., 2023). Additionally, educating food pantry staff and clients on the meaning of food date labels on pre-cut fruits and vegetables can prevent discarding those that are still safe to consume (Neff, et al., 2019)

Moving forward, recognizing that participation in nutrition assistance programs is associated with reduced household waste of nutritious food during times of distress may help promote transdisciplinary research collaboration. Food waste research, where the major focus is on agri-food systems and their environmental impacts, and public health nutrition research have not been well integrated in the U.S. and elsewhere, even though they share the same goals of efficiently distributing healthy food, reducing food waste, and eliminating hunger (Santeramo & Lamonaca, 2021). We suggest expanding the collaboration with stakeholders from other sectors of the food system—food production, food processing, food retail, and food service—to advance this agenda through evidence-based and scenario analyses.

## Acknowledgment

We thank Dr. Roni Neff of Johns Hopkins University for her guidance in the questionnaire development of the series of food access surveys.

## References

2025 Dietary Guidelines Advisory Committee. (2024). *USDA scientific report of the 2025 Dietary Guidelines Advisory Committee: Advisory report to the Secretary of Health and Human Services and Secretary of Agriculture.* U.S. Department of Health and Human Services. https://doi.org/10.52570/DGAC2025

Aschemann-Witzel, J., Giménez, A., & Ares, G. (2019). Household food waste in an emerging country and the reasons why: Consumers' own accounts and how it differs for target groups. *Resources, Conservation and Recycling*, *145*, 332–338. https://doi.org/10.1016/j.resconrec.2019.03.001

Bellemare, M. F., Çakir, M., Peterson, H. H., Novak, L., & Rudi, J. (2017). On the measurement of food waste. *American Journal of Agricultural Economics*, *99*(5), 1148–1158. https://doi.org/10.1093/ajae/aax034

Bertmann, F., Rogomentich, K., Belarmino, E. H., & Niles, M. T. (2021). The food bank and food pantries help food insecure participants maintain fruit and vegetable intake during COVID-19. *Frontiers in Nutrition*, *8*, Article 673158. https://doi.org/10.3389/fnut.2021.673158

Buzby, J. C., Farah-Wells, H., & Hyman, J. (2014). *The estimated amount, value, and calories of postharvest food losses at the retail and consumer levels in the United States*. USDA-ERS Economic Information Bulletin, (121). https://doi.org/10.2139/ssrn.2501659

Daniel, C. (2016). Economic constraints on taste formation and the true cost of healthy eating. *Social Science & Medicine*, *148*, 34–41. https://doi.org/10.1016/j.socscimed.2015.11.025

Eicher-Miller, H. A. (2020). A review of the food security, diet and health outcomes of food pantry clients and the potential for their improvement through food pantry interventions in the United States. *Physiology & Behavior*, *220*, Article 112871. https://doi.org/10.1016/j.physbeh.2020.112871

Engel, K., & Ruder, E. H. (2020). Fruit and vegetable incentive programs for Supplemental Nutrition Assistance Program (SNAP) participants: A scoping review of program structure. *Nutrients*, *12*(6), Article 1676. https://doi.org/10.3390/nu12061676

Fadnes, L. , Taube, A., & Tylleskär, T. (2008). How to identify information bias due to self-reporting in epidemiological research. *The Internet Journal of Epidemiology*, *7*(2), 28–38. https://ispub.com/IJE/7/2/9194

Feingold, B. J., Torres Arroyo, M. M., Hosler, A. S., Craft, T., Myo, H. W. L., Bozlak, C. T., Romeiko, X. X., Pernicka, N., Crasto-Donnelly, P., Klein, A., Pettigrew, S., Atwood, B., & Neff, R. (2021). *Impacts of the first year of COVID-19 on food security in the New York's Capital Region* [Environmental Health Sciences Faculty Scholarship Paper No. 5]. Environmental Health Sciences Faculty Scholarship. https://scholarsarchive.library.albany.edu/ehs_fac_scholar/5

Ghafoorifard, N., Mesler, R. M., & Basil, M. (2022). Economic hardship, ontological insecurity, and household food waste. *Food Quality and Preference*, *97*, Article 104402. https://doi.org/10.1016/j.foodqual.2021.104402

Grier-Welch, A., Marquis, J., Spence, M., Kavanagh, K., & Anderson Steeves, E. T. (2021). Food acquisition behaviors and perceptions of food pantry use among food pantry clients in rural Appalachia. *Ecology of Food and Nutrition*, *60*(1), 70–88. https://doi.org/10.1080/03670244.2020.1793138

Hargittai, E., Piper, A. M., & Morris, M. R. (2019). From internet access to internet skills: Digital inequality among older adults. *Universal Access in the Information Society*, *18*(4), 881–890. https://doi.org/10.1007/s10209-018-0617-5

Havas, S., Heimendinger, J., Reynolds, K., Baranowski, T., Nicklas, T. A., Bishop, D., Buller, D., Sorensen, G., Beresford, S.A.A., Cowan, A.,& Damron, D. (1994). 5 a day for better health: A new research initiative. *Journal of the Academy of Nutrition and Dietetics* , *94*(1), 32–36 https://doi.org/10.1016/0002-8223(94)92037-0

Haynes-Maslow, L., Auvergne, L., Mark, B., Ammerman, A., & Weiner, B. J. (2015). Low-income individuals' perceptions about fruit and vegetable access programs: A qualitative study. *Journal of Nutrition Education and Behavior*, *47*(4), 317–24. e1. https://doi.org/10.1016/j.jneb.2015.03.005

Hosmer, D. W., Taber, S., & Lemeshow, S. (1991). The importance of assessing the fit of logistic regression models: A case study. *American Journal of Public Health*, *81*, 1630–1635. https://doi.org/10.2105/AJPH.81.12.1630

Huang, J., Acevedo, S., Bejster, M., Kownacki, C., Kehr, D., McCaffrey, J., & Nguyen, C. J. (2023). Distribution of fresh foods in food pantries: Challenges and opportunities in Illinois during the COVID-19 pandemic. *BMC Public Health*, *23*, Article 1307. https://doi.org/10.1186/s12889-023-16215-4

Kihlstrom, L., Long, A., & Himmelgreen, D. (2019). Barriers and facilitators to the consumption of fresh produce among food pantry clients. *Journal of Hunger & Environmental Nutrition*, *14*(1–2), 168–182. https://doi.org/10.1080/19320248.2018.1512923

Kinsey, E. W., Kinsey, D., & Rundle, A. G. (2020). COVID-19 and food insecurity: An uneven patchwork of responses. *Journal of Urban Health*, *97*(3), 332–335. https://doi.org/10.1007/s11524-020-00455-5

Larison, L., Shanks, C. B., Webber, E., Routh, B., & Ahmed, S. (2021). The influence of the COVID-19 pandemic on the food supply in the emergency food system: A case study at 2 food pantries. *Current Developments in Nutrition*, *5*(10), Article nzab115. https://doi.org/10.1093/cdn/nzab115

Lee, M. M., Poole, M. K., Zack, R. M., Fiechtner, L., Rimm, E. B., & Kenney, E. L. (2023). Food insecurity and the role of food assistance programs in supporting diet quality during the COVID-19 pandemic in Massachusetts. *Frontiers in Nutrition*, *9*, Article 1007177. https://doi.org/10.3389/fnut.2022.1007177

Lee, S. H., Moore, L. V., Park, S., Harris, D. M., & Blanck, H. M. (2022). Adults meeting fruit and vegetable intake recommendations—United States, 2019. *Morbidity and Mortality Weekly Report (MMWR)*, *71*(1), 1–9. https://doi.org/10.15585/mmwr.mm7101a1

Long, C. R., Bailey, M. M., Cascante, D. C., Purvis, R. S., Rowland, B., Faitak, B. M. S., Gittelsohn, J., Caspi, C. E., English, E. S. & McElfish, P. A. (2023). Food pantry clients' needs, preferences, and recommendations for food pantries: A qualitative study. *Journal of Hunger & Environmental Nutrition*, *18*(2), 245–260. https://doi.org/10.1080/19320248.2022.2058334

MITRE & Gallup. (2023). *The state of food waste in America: 2023 Report*. https://sites.mitre.org/household-food-waste/wp-content/uploads/sites/41/2023/11/The-State-of-Food-Waste-in-America-11-14-23.pdf

Neff, R. A., Spiker, M., Rice, C., Schklair, A., Greenberg, S., & Leib, E. B. (2019). Misunderstood food date labels and reported food discards: A survey of U.S. consumer attitudes and behaviors. *Waste Management*, *86*, 123–132. https://doi.org/10.1016/j.wasman.2019.01.023

New York State Department of Agriculture and Markets. (n.d.). *Nourish New York: Supporting New York farms and communities*. Retrieved December 28, 2025, from https://agriculture.ny.gov/NourishNY

New York State Department of Labor. (2026). *Labor market briefing: Capital Region, July 2026*. https://dol.ny.gov/labor-market-briefing-capital-region

Niles, M. T., Beavers, A. W., Clay, L. A., Dougan, M. M., Pignotti, G. A., Rogus, S., Savoie-Roskos, M. R., Schattman, R. E., Zack, R. M., Acciai, F., Allegro, D., Belarmino, E. H., Bertmann, F., Biehl, E., Birk, N., Bishop-Royse, J., Bozlac, C., Bradley, B., Brenton, B., ... & Yerxa, K. (2021). A multi-site analysis of the prevalence of food insecurity in the United States, before and during the COVID-19 pandemic. *Current Developments in Nutrition*, *5*(12), Article nzab135. https://doi.org/10.1093/cdn/nzab135

Pruden, B., Poirier, L., Gunen, B., Park, R., Hinman, S., Daniel, L., Gu, Y., Katragadda, N., Weiss, J., & Gittelsohn, J. (2020). Client choice distribution model is associated with less leftover food in urban food pantries. *Current Developments in Nutrition*, *4*(Suppl. 2), Article nzaa053_117. https://doi.org/10.1093/cdn/nzaa043_117

Pryor, S., & Dietz, W. (2022). The COVID-19, obesity, and food insecurity syndemic. *Current Obesity Reports*, *11*(3), 70–79. https://doi.org/10.1007/s13679-021-00462-w

ReFED. (n.d.). *Insights engine: 24.1 million food waste tons were generated in residential areas across all states in 2023* [Interactive Infographic]. Retrieved December 28, 2025, from https://insights-engine.refed.org/food-waste-monitor?break_by=food_type&indicator=tons-waste&sector=residential&view=detail&year=2023

Restrepo, B. J. (2023). The protective effect of SNAP during economic downturns: Evidence from the COVID-19 pandemic. *Applied Economic Perspectives and Policy*, *45*(4), 2141–2160. https://doi.org/10.1002/aepp.13345

Rodgers, R. F., Lombardo, C., Cerolini, S., Franko, D. L., Omori, M., Linardon, J., Guillaume, S., Fischer, L., & Fuller-Tyszkiewicz, M. (2021). "Waste not and stay at home" evidence of decreased food waste during the COVID-19 pandemic from the US and Italy. *Appetite*, *160*, Article 105110. https://doi.org/10.1016/j.appet.2021.105110

Santeramo, F. G., & Lamonaca, E. (2021). Food loss–food waste–food security: A new research agenda. *Sustainability*, *13*(9), Article 4642. https://doi.org/10.3390/su13094642

Schanes, K., Dobernig, K., & Gözet, B. (2018). Food waste matters - A systematic review of household food waste practices and their policy implications. *Journal of Cleaner Production*, *182*, 978–991. https://doi.org/10.1016/j.jclepro.2018.02.030

U.S. Environmental Protection Agency [US EPA]. (2023a). *From field to bin: The environmental impacts of U.S. food waste management pathways*. https://www.epa.gov/system/files/documents/2023-10/part2_wf-pathways_report_formatted_no-appendices_508-compliant.pdf

U.S. Environmental Protection Agency [US EPA]. (2023b). *2019 Wasted food report estimates of generation and management of wasted food in the United States in 2019*. https://www.epa.gov/system/files/documents/2024-04/2019-wasted-food-report_508_opt_ec_4.23correction.pdf

Wetherill, M. S., White, K. C., Rivera, C., & Seligman, H. K. (2019). Challenges and opportunities to increasing fruit and vegetable distribution through the US charitable feeding network: Increasing food systems recovery of edible fresh produce to build healthy food access. *Journal of Hunger & Environmental Nutrition*, *14*(5), 593–612. https://doi.org/10.1080/19320248.2018.1484315

Winkler, L., Goodell, T., Nizamuddin, S., Blumenthal, S., & Atalan-Helicke, N. (2023). The COVID-19 pandemic and food assistance organizations' responses in New York's Capital District. *Agriculture and Human Values*, *40*, 1003–1017. https://doi.org/10.1007/s10460-022-10400-8

Woo Baidal, J., Finkel, M. A., Kelman, E., Duong, N., Bien-Aime, C., Goldsmith, J., Albrecht, S. S., Hulse, E., Rosenthal, A., Reiss, J., Schwartz, R., Meyer, D., & HERALD Collaborative. (2024). Longitudinal associations of food security with health and dietary factors among food FARMacy participants during COVID-19 in New York City. *Nutrients*, *16*(3), Article 434. https://doi.org/10.3390/nu16030434

Yu, Y., & Fan, L. (2023). Evaluating food assistance programs in the presence of food waste: The case of SNAP. *SSRN*, Article 4557513. https://doi.org/10.2139/ssrn.4557513

Yu, Y., & Jaenicke, E. C. (2020). Estimating food waste as household production inefficiency. *American Journal of Agricultural Economics*, *102*(2), 525–547. https://doi.org/10.1002/ajae.12036