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ABSTRACT

Little is known about the factors that contribute to the management and acquisition of food in rural, food insecure households. In this study, caregivers (N=61) with school-aged children living in rural, food insecure households were asked to complete a series of baseline questionnaires and tasks, followed by daily surveys over 35 days, which measured household food insecurity, food environment, depressive symptoms, and food-based coping strategies. Results showed that in circumstances where food insecurity is more severe, caregivers engage in more private (at-home) management strategies, and less in public food acquisition. Additionally, caregivers also engaged in more private management strategies and less private food acquisition when experiencing more severe depressive symptoms. These findings suggest that caregivers with severe food insecurity or depressive symptoms may be at risk for disengagement from external support systems around them, relying on themselves to mitigate their food insecurity. The results obtained from this study provide insight into how we may potentially re-evaluate the focus of current food-assistance program initiatives to fit the needs of rural communities.

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INTRODUCTION

Food Insecurity and Coping Strategies

Food insecurity is a social condition in which "the availability of nutritionally adequate and safe foods or the ability to acquire acceptable foods in socially acceptable ways is limited or uncertain" (Coleman-Jensen, 2010). In 2021, food insecurity was estimated to affect up to 12.5% of households in the United States, approximately half of which contained children (USDA Economic Research Service, 2022). Food insecurity in the United States was exacerbated by the COVID-19 pandemic. During the first year of the pandemic, there was a 32% increase in household food insecurity, with individuals experiencing recent job loss being at a greater risk of being food insecure (Niles et al., 2020). Although the prevalence of food insecurity has since decreased, it still remains elevated compared to pre-pandemic rates (i.e., 10.5% in 2019; Coleman-Jensen et al., 2020).

To cope with limited resources, food insecure individuals have been shown to engage in a variety of strategies to manage and acquire food outside of shopping at the grocery store (i.e., food-based coping strategies). In prior research studies, these alternative methods were classified into two categories; negative responses (e.g., sleeping, drinking, and isolating oneself to avoid thinking about food insecurity) and positive responses such as, relying on the support of friends and family, praying, and seeing a mental health professional (Leung et al., 2022). However, simply grouping all food-based coping strategies under either of the two categories does not depict the complexity of these strategies. In Leung, et al (2022) negative responses describe methods of disengagement from food insecurity. The researchers did not identify any responses that addressed food insecurity directly, such as obtaining aid from friends, family, or food

assistance programs. It is well documented that individuals with food insecurity participate in various government and community-based food assistance programs to reduce their food insecurity. The largest among the nutrition assistance programs administered by the USDA is the Supplemental Nutrition Assistance Program (SNAP), which had 37.3 million average monthly users in 2020 (Toosi et al., 2022). Therefore, when examining the strategies households use to cope with food insecurity, one should take into account coping responses that directly address food insecurity. Additionally, not all negative responses can be considered disengagement from food insecurity. For instance, skipping meals may be considered a negative response to food insecurity, however for many individuals this can be a coping mechanism that successfully stretches out the available food so that it will last the month.

Although there are few studies surrounding these strategies used to mitigate food insecurity, some research suggests that there is an interaction between food insecurity and food management and acquisition strategies utilized by food insecure caregivers. In South Korea, researchers found that low-income households using less active sharing of food among private networks (i.e., friends and family), struggled with food insecurity more than those that frequently engage in active sharing (Park & Kim, 2018). The results from Park and Kim (2018) suggest that a lack of familial support and/or support from friends may exacerbate food insecurity. Shame and stigma associated with food insecurity may contribute to relying less on members of one's private network for support. Indeed, past work has shown that, in response to the feelings of shame, caregivers with food insecurity avoid public food assistance programs near their residence, hide food stamps, and conceal their food insecurity from members of their inner circle (Leung, et al., 2022; Swales, et al., 2020). In addition, caregivers with food insecurity report

fears of being perceived as being a failure as a provider, suggesting that caregiver status may be relevant to the types of coping strategies employed to mitigate hunger (Swales, et al., 2020).

Food Environment (Accessibility)

In the United States, food insecurity disproportionately burdens rural communities, with many households located in *food deserts* (Gundersen et al., 2017). According to the United States Department of Agriculture (USDA), food deserts are characterized by communities with low income, where at least one third of the population live more than one mile (in urban areas) or more than ten miles (in rural areas) from the nearest supermarket, supercenter, or larger grocery store (Ver Ploeg et al., 2011). As a result, food insecure individuals shop more frequently at small convenience or dollar stores compared to their food secure counterparts (Ma et al., 2017). More specifically, a recent study showed that food insecure individuals shopped more times per month at convenience stores and smaller grocery stores compared to food secure individuals (Lenk et al., 2020). Similarly, food insecure individuals spent two times more compared to food secure individuals at dollar stores. These types of stores are known to have less fresh and more expensive produce than supermarkets, thereby making it difficult to consume a balanced diet that includes fruits and vegetables (Kendall et al., 1996; Ma et al., 2017). In one study, the produce in California convenience stores was on average 102 percent more expensive than those found at chain supermarkets (Gosliner et al, 2018). This disparity may lead to a choice between either exhausting the household's budget on produce or consuming less fruits and vegetables.

Moreover, differences in access to supermarkets and supercenters have larger implications for those that are food insecure in rural areas compared to those in urban areas.

Rural areas are found to have fewer food outlets[1] per square mile compared to urban areas

(Gantner et al., 2011). For example, in rural, northern New York less than 1 percent of

households have a supermarket as their nearest food outlet within a 20-mile radius (Gantner et

al., 2011). Rural food environments tend to be unique in that there are limited food outlets and

fewer healthy, quality[2] foods, including fruits and vegetables (Pinard et al., 2016; Smith &

Morton, 2009; Yousefian et al., 2011). Often, there is a discrepancy between the types of foods

that households desire and those that they have direct access to consume. Rodriguez and

Grahame (2016) found that food insecure individuals reported wanting to eat fruits and

vegetables but were unable to do so due to access limitations (Rodriguez & Grahame, 2016).

Furthermore, household food insecurity has been shown to decrease with improved

transportation accessibility, implying that physical access, in addition to the economic resources,

impacts households' level of food insecurity and the strategies used for acquiring and managing

food (Baek, 2016; Piaskoski et al., 2020; Yousefian et al., 2011). While it is clear that greater

distances to storefronts, and limited selection of cost-effective produce in rural areas are

the important barriers to healthy food acquisition, very few studies have examined how

rural, food insecure caregivers cope with these limitations.

Food Insecurity and Depressive Symptoms

Household food insecurity has been well established in the literature as a risk factor for

poor mental health. This relationship is consistent across socioeconomic levels, geographic

location, and culture (Jones, 2017). More specifically, individuals struggling with food insecurity

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[1] Food outlets refer to stores that sell food such as convenience stores, dollar stores, supermarkets, and fast food restaurants.

[2] The quality of foods refers to the use of pesticides and whether products are fresh or outdated and spoiled. (Smith & Morton, 2009).

have been found to have a 2.5 times higher risk of depression compared to food secure individuals (Fang et al., 2021). In these studies, severe food insecurity was associated with symptoms of depression, as well as suicidal ideation, and substance misuse (Martin et al., 2016; Pryor et al. 2016; Wolfson et al., 2021). While this co-occurrence between food insecurity and depression has been widely studied, the impact of depressive symptoms on the ways in which food insecure individuals acquire and manage food is not well understood.

The emotional, behavioral, and cognitive symptoms of depression may affect the management and acquisition behaviors used to cope with food insecurity. For instance, regardless of age, individuals who report depressive symptoms are twice as likely to display highly sedentary behaviors (Stubbs et al., 2018). In the context of food insecurity, these sedentary behaviors may decrease the time adults spend on physically acquiring food from supermarkets, friends, or family. Furthermore, depression is highly correlated with cognitive dysfunction, including deficits in attention, memory, and processing speed (Wei et al., 2019). Given these challenges, it is possible that food insecure individuals with depressive symptoms would have difficulty planning effectively. Notably, there is a considerable amount of planning related to distributing the benefits received from government issues food assistance programs (e.g., Women/Infants/Children (WIC) and Supplemental Nutrition Assistance Program (SNAP)). For instance, SNAP participants receive approximately $218 per person in each household per month (approximately $7.17 per day), which must be arranged to last the month (Center on Budget and Policy Priorities, 2022). In fact, Rose (2007) found that, in order for these benefits to suffice for a full month, households would need to engage in over 14 hours a week of meal preparation for a family of four. Similarly, and specific to Vermont, individuals enrolled in local programs, such as Farm to Family, receive coupons that must be used effectively so that they last

the month. Considering that substantial planning is necessary for the use of nutritional assistance programs, it is plausible that depression would highly affect the food acquisition strategies and behaviors of food insecure individuals; however, this has not yet been formally studied.

Current Study & Hypotheses

The current study focused on examining how food insecurity, food environment, and depressive symptoms effect the ways in which caregivers acquire and manage food. These relations were studied specifically in the context of rural communities in order to understand challenges related to a limited food environment.[3] Based on the existing literature, it was expected that (1) higher levels of food insecurity will be associated with the utilization of more food acquisition outside of the family ; (2) following studies like Lenk, et al., (2020) individuals in a more limited food environment will rely more upon methods outside of the family, and specifically, smaller convenience stores, to acquire food needs, and (3) more severe depressive symptoms will be associated with an overall decrease in food acquisition, with the most substantial decrease in strategies that require engagement outside of the family. By examining the effects of food insecurity, food environment, and depressive symptoms on the strategies used by food insecure caregivers to acquire and manage food, this study will contribute important insights into the functioning of rural, food insecure households, which can help identify patterns that exacerbate or ameliorate food insecurity.

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[3] The food environment refers to access to food outlets and quality, healthy foods. A major factor of accessibility to healthy foods is the availability of fresh produce in nearby stores.

Methodologyii

Participants

This study was a secondary analysis of data obtained from a parent study (PI: Merelise Ametti) conducted in the Child Emotion Regulation Laboratory under the direction of Dr. Robert Althoff during the 2020-2021 school year. The study was approved by the University of Vermont Institutional Review Board (Study #1034). Participants were 61 caregivers living in rural Vermont, New Hampshire, and New York who met the following eligibility criteria: (1) 18 years of age or older, (2) speak and read in English, (3), legal guardian of a child between the ages of 6 and 12 with whom they lived at least 75% of the time, (4) endorse worries about and/or actual food insufficiency within the past 30 days, (5) reside in a county designated as rural by the Health Resources and Services Administration (HRSA), and (6) have access to technology with text messaging and video conferencing capabilities.

Procedures

Participants were recruited through online advertisements disseminated via social media and screened for eligibility either by phone or online questionnaire. Those who met the aforementioned criteria for inclusion were provided the opportunity to attend a baseline study visit. Due to the COVID-19 pandemic, the baseline study visit was conducted remotely, lasting approximately 2.5 hours. Directly following consent procedures, participants completed a series of online questionnaires and computer tasks. Then, beginning the next day, participants received daily surveys for 35 days that assessed variation in food insecurity, depressive symptoms, and strategies used to cope with food insecurity over the course of a month. Daily surveys were automatically sent every evening, at a time of the participants' choosing (e.g., between 7:00-

9:30PM), through Mosio, an automated text-messaging program. Participants received up to two reminders each evening to complete the survey at 45-minute intervals. The surveys remained open until 7AM the following morning to accommodate caregivers that may work at night. As an incentive to complete the baseline and daily surveys, participants had the opportunity to earn up to $225.00. Participants earned $35.00 for participating in the baseline study visit. In addition, participants earned between $2.00 and $6.00 per day for completion of daily surveys, with the value increasing the longer they remained in the study. All compensation was received at the conclusion of participation.

Baseline Measures

USDA Household Food Security Survey Module (HFSSM)

The USDA Household Food Security Survey (HFSSM; Bickel, et al., 2000) consists of 18 questions designed to measure overall degree of household food security during the past year. The HFSSM yields a Household Food Security score ranging from 0 to 18 and an Adult Food Security score ranging from 0 to 10, in which a higher score indicates more severe challenges with food security. In addition, these scores were qualitatively categorized into "high food security" (i.e., no anxiety or changes in food intake), "marginal food security" (i.e., anxiety but no changes in food intake), "low food security" (i.e., decreased quality and variety of food intake) and "very low food security." (i.e., decreased quantity and quality of food intake).

Neighborhood Food Environment Scale (NFES)

The Neighborhood Food Environment Scale (NFES; Ma, et al., 2013) includes 14-items that measure an individual's access to food and examines how individuals perceive their food environment. Specifically, the questionnaire asks about food accessibility within a 20-minute

walk or one-mile radius from their home. The items formed two subscales: (1) the NFES

Composite Score, which represented the availability and quality of fresh fruit and vegetables as

well as the availability of low-fat products, and (2) the NFES Perception Score, which also

included opportunities to purchase fast food and problems related to accessing food shopping.

Adult Self Report Form (ASR)

The Adult Self Report Form (ASR; Achenbach & Rescorla, 2003) was used to measure

caregivers' emotional and behavioral problems during the past six months using a set of 135

items. The items were assessed on a three-point scale (*0 = not true; 1 = somewhat or sometimes*

true; 2 = very true or often true). The ASR produces subscales which are normed by age, gender,

and culture. For the current study, *t*-scores from the Internalizing Problems scale, encompassing

Anxious-Depressed, Withdrawn, and Somatic Complaints subscales, were used as a global

measurement of caregivers' baseline depressive symptoms.

Short Form Health Survey (SFHS)

The Short Form Health Survey (SFHS; Ware & Sherbourne, 1992) consisted of 36-items

designed to measure functioning related to general physical health. The SFHS produces

subscales which yield averaged scores between 0 and 100, with higher scores representing better

health. In the current study, the Social Functioning and Physical Functioning subscales were

used as measurements of caregivers' overall physical health.

Daily Measures

Total Daily Food Insecurity

Total daily food insecurity was assessed using five items relating to unbalanced meals

and financial troubles. Participants were asked: (1) "at any point today, did you worry whether

food would run out before you got the money to buy more," (2) "today, how much did you feel you couldn't afford to eat balanced meals," (3) "did you eat less today than you felt you should because there wasn't enough money to buy food," (4) "how much did you feel today that you could not afford to feed your child(ren) balanced meals," (5) "did your child(ren) eat less today than you felt they should because there wasn't enough money to buy food?" These items were then summed to create a total daily food security score, ranging from 0 to 7 with higher scores indicated more severe experiences of daily food insecurity.

Daily Depressive Symptoms

Daily depressive symptoms were assessed using the question, "How depressed did you feel today?" Participants answered on a five-point scale (*1 = very slightly or not at all; 2 = a little; 3 = moderately; 4 = quite a bit; 5 = extremely*) that determined the severity of their depressive symptoms that day.

Food-Based Coping Strategies

To measure food-based coping strategies, a qualitative question asking whether participants had done anything that day to cope with not having enough food was assessed. The written responses were qualitatively coded into the following three categories: (1) *public acquisition,* which included behaviors intended to procure food through structured, community-based methods, such as participating in governmental nutrition assistance programs, food banks, and shopping at food outlets; (2) *private acquisition*, which includes behaviors used to procure food through interpersonal methods, such as like relying on shared food in the workplace, family, friends, or neighbors, and (3) *private management,* which included strategies intended to maximize available food, such as rationing food, skipping meals, or smoking to suppress appetite.

Food Purchase Location

Participants were asked "did you buy any food today, including from restaurants, grocery stores, convenience stores, or other locations?" (*0 = no; 1 = yes*). Upon answering yes, participants were prompted to answer a short-written response asking where the purchase was made. Responses were coded into the following four types of purchase locations: (1) grocery stores, (2) convenience stores, (3) fast food, and (4) discount stores.

Data Analysis

For the first and third hypotheses, multi-level models (MLM) were conducted using R version 4.2.2. MLM is a form of regression analysis that decomposes variability in observed variables into within-person (Level 1) and between-person (Level 2) levels. Specifically, days (Level 1) were nested within caregivers (Level 2) (Curran & Bauer, 2011). Analyses made use of 1,830 person-days (61 participants x 30 days).[4] More specifically, MLM were tested with daily food insecurity (hypothesis 1) and daily depressive symptoms (hypothesis 3) predicting the use of public acquisition, private acquisition, and private management strategies. In addition, for the second hypothesis, a series of multiple linear regression model were performed using IBM SPSS Statistics Version 28.0, wherein neighborhood food environment predicted the frequency with which each category of food-based coping strategy was used over the course of the month. In all models, Social Functioning, Physical Functioning, Internalizing Problems, and the number of food assistance programs in use were added as covariates and those that were statistically significant were retained in the final models.

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[4] The weekly surveys from the parent study were not included in the analyses.

RESULTS

Descriptive Statistics

Of the 533 candidates screened for potential inclusion into the parent study, 59.1 percent met all eligibility criteria (see Table 1). The most common reasons for exclusion were not having a child between the ages of 6 and 12 (79.2 %) and not endorsing food insecurity during the past month (13.3%). Other reasons for exclusion are shown in Table 1. Of the candidates who met inclusionary criteria, 81% declined to participate or failed to attend the scheduled baseline study visits. As a result, 61 caregivers enrolled in the study. Following enrollment, 58 caregivers (95.1%) were retained for the entire study duration. The most common reasons for withdrawal were participation in another study ($n=1$), finding daily surveys too burdensome ($n=1$), and discomfort with computerized cognitive tasks ($n=1$). Participants completed 90.4 % of the daily surveys with over half of the participants completing all of the daily surveys.

As illustrated in Table 2, 84% of caregivers identified as female and their mean age was 36.1 years (SD=5.9). The majority of participants identified as white (93.4 %), which is consistent with Vermont and New Hampshire's 2020 Census data (U.S Census Bureau, 2021). Regarding food insecurity, 52.5% of caregivers reported very low food security, 42.6% reported low food security, and only 3.3% reported high food security. Educational attainment ranged from less than a high school diploma to graduate degrees, with the most common being some college, but no degree (26.2%). There was also considerable variability within the sample in relation to caregivers' employment status, annual income, and participation in food assistance programs. As shown in Table 3, all households received some form of food assistance with the School Lunch and Breakfast Program (82.0%), SNAP (73.8%), and WIC (65.6%) being most utilized.

Zero-order correlations calculated among the primary baseline measures are presented in Table 4. Given that the Household Food Insecurity scale was extremely highly correlated with the Adult Food Insecurity scale, (r[58] = 0.96, p= <0.001), only the Adult Food Insecurity scale was used in subsequent analyses. In addition, both the Food Environment Composite and Perception scores were significantly, positively correlated with Adult Food Insecurity (r[58] = 0.48, p= <0.001; r[58]= 0.47, p= <0.001 respectively), indicating that more limited food environments were associated with more severe food insecurity. Adult Food Insecurity scores were positively correlated with the broadband Internalizing Problems subscale of the ASR (r[58] = 0.35, p = <0.01), but not the Anxious/Depressed and Withdrawn subscales. Finally, both Physical Functioning and Social Functioning scores were significantly negatively correlated with Adult Food Insecurity. Therefore, these constructs were included within the multi-level model analysis as covariates, in addition to the Internalizing Problems scale and the total number of food assistance programs utilized by caregivers.

For daily survey items, unconditional multi-level models, including no predictors, were conducted to produce means and variance estimates, which were used to calculate intraclass correlations (ICCs). As shown in Table 5, all daily items had ICCs less than 0.90, indicating that sufficient variability can be attributed to within-person differences, thereby justifying the use of a multi-level modeling approach.

Research Question #1

The first research question explored the association between daily levels of food insecurity and the type of food-based coping strategy employed. To test the hypothesis that higher levels of food insecurity would be associated with the utilization of more public methods

of food acquisition, a multi-level model analysis was performed with total daily food insecurity

predicting the use of each type of food-based coping strategy (i.e., public, private acquisition, or

private management). As shown in Table 6, at the within-person level, daily food insecurity was

negatively associated with the use of public acquisition strategies and positively associated with

the use of private management strategies. This indicates that, contrary to the hypothesis, higher

than usual daily reports of food insecurity were related to reports of decreased acquisition of

food through public methods, and increased reliance on private management strategies. At the

between-person level, food insecurity was negatively associated with the use of private

acquisition strategies. This indicates that participants who, on average, reported higher food

insecurity also reported less frequent use of private methods of food acquisition, although this

association was not observed on a daily basis. As none of the proposed covariates (i.e., physical

functioning, social functioning, internalizing problems, and food assistance programs in use)

contributed significantly to the model fit, they were excluded from the final model.

Research Question #2

  The second research question explored the association between food environment at

baseline and type of food-based coping strategy employed. It was hypothesized that individuals

living in a limited food environment would rely more on public food acquisition strategies to

meet dietary needs. Particularly, individuals would purchase from smaller convenience stores

most often in more limited food environments. Overall, the results of linear regression analyses

did not support the hypothesis. More specifically, the results showed that neither the Food

Environment Composite nor Perception scores were significantly associated with any specific

type of food-based coping strategy used over the course of the study (see Table 7). Only the

Internalizing Problems score was significant. Moreover, increased internalizing problems were associated with less frequent use of public acquisition strategies and more frequent use of private management strategies (b= -0.44, t[25]= -2.35, p<0.027; b= 0.52, t[25]= 3.04, p<0.006, respectively). Similarly, neither Food Environment Composite nor Perception scores were associated with the frequency with which each caregiver purchased food at specific locations during the one month time period.

Research Question #3

The third and final research question explored the association between daily depressive symptoms and types of food-based coping strategy employed. It was hypothesized that more severe depressive symptoms would be associated with a decrease in all forms of food acquisition, with the most severe effect on public acquisition. To investigate this, a multi-level model was performed with caregivers' daily depression scores predicting the type of food-based coping strategy utilized at both the within and between-person levels. Results showed that, at the within-person level, daily depressive symptoms were negatively associated with the use of private methods of food *acquisition* (e.g., obtaining free meals from friends, family, or the workplace) and positively associated with methods of private *management* (e.g., skipping meals and smoking; see Table 9). No significance was found at the between-person level for any specific food-based coping strategy. This suggests that on a given day, caregivers' reports of more severe depressive symptoms than usual were related to the use of more use of private management strategies. Notably, this relationship between daily depressive symptoms and private management strategies persisted, despite the negative association between day in study

and the use of private management strategies (see Table 9). None of the covariates contributed significantly to model fit and were therefore excluded.

Follow-Up Analysis

Given that both daily food insecurity and depressive symptoms were associated with the types of coping strategies used, a follow-up analysis was conducted simultaneously including daily food insecurity, depressive symptoms, and the mean-centered interaction between them on the use of each type of coping strategy. Results showed that both daily food insecurity and depressive symptoms had independent main effects on the same specific coping strategies in the prior model fits. The interaction term of food insecurity and depressive symptoms was not significant for any of the types of coping strategies at either the between- or within-person level, suggesting that daily food insecurity and depressive symptoms have independent effects on type of daily coping strategies employed (see Table 9).

DISCUSSION

Summary of the Study

The objective of this study was to investigate whether food environment, food insecurity, and depressive symptoms impact the strategies used by rural caregivers to cope with food insecurity. The results of the first research question suggested that caregivers tend to engage in more private (at-home) management strategies and less public food acquisition on days when they experience more severe food insecurity. Furthermore, caregivers experiencing higher food insecurity on average used less private acquisition strategies, compared to those who experienced lower food insecurity. Ultimately, it was demonstrated that in times of greater scarcity, caregivers rely on management strategies aimed at decreasing their own food intake rather than strategies that aid in the procurement of additional food. For example, caregivers described skipping meals or engaging in distracting behaviors such as, drinking coffee, water, or smoking rather than seeking out food from food banks, friends, or family.

Although contrary to my first hypothesis, these findings are consistent with past research by Swales, et al. (2020), which found that, despite experiencing food insecurity, individuals may refuse to obtain aid from family, friends, or food assistance programs due to the intense feelings of shame that accompanies food insecurity. Moreover, in Swales et al. (2020) feelings of shame were associated with lower engagement in food assistance programs, suggesting that shame prevents individuals with food insecurity from reaching out to others. Similarly, Bernal et al. (2016) identified that severity of food insecurity was positively correlated with feelings of shame, which further support the role of shame in influencing the selection of food-based coping strategies. Although this study did not explore shame as a mediator between food insecurity and food-based coping strategies, it is possible that on days where food insecurity is highest,

caregivers may feel more shame, resulting in less engagement in external food-based coping strategies (i.e., private and public food acquisition) and greater reliance on private management strategies to meet their households' nutritional needs.

Another important finding of this study was that the food environment did not predict the types of food-based coping strategies used or the locations where food was purchased among rural, food insecure caregivers. Thus, the findings from Lenk et al., (2020) and Ma et al., (2017) suggesting an association between increased food insecurity and increased convenience stores/dollar store purchases was not replicated in this study. This could be due to this study's limited, small size or due to the sample having limited variability regarding caregivers' food environments, as all households resided in rural communities.

Finally, the present study found that on days when depressive symptoms were more severe, caregivers engaged in less private food acquisition, and more private management strategies. Caregivers' reliance on private management strategies may be indicative of the sedentary and isolative behaviors associated with depression (Ge et al., 2017; Stubbs et al., 2018). Another factor that accompanies depression symptomatology is making lower *productivity* decisions. Productivity describes how beneficial or 'in the best interest of the person' an outcome of a decision may be. Lower productivity decisions may be optimal in the moment, however, over time they begin to oppose the individual's best interest (Leykin, et al., 2010). Additionally, individuals with high scores on the Beck Depression Inventory-II (BDI) more often chose decisions in hypothetical social scenarios that, in the past, resulted in adverse outcomes compared to individuals with low BDI scores (Leykin, et al., 2010). This may explain why caregivers tend to engage in private management strategies over those that may be more advantageous in the long-term at relieving their food insecurity on days where they experience

higher depressive symptoms. For instance, acquiring food from friends, family or the workplace could increase the total amount of food available throughout the month and reduce the need for more extreme sacrifices, such as skipping meals. Nonetheless, our results suggest that caregivers with depressive symptoms are more likely to decrease their food intake rather than ask for aid.

Limitations

Although this study has provided many insights into the food-based coping strategies utilized by rural, food insecure caregivers, there are several limitations that reduce the external validity of the study. For instance, the results cannot be generalized to all food insecure individuals living in the United States due to the homogeneous demographics of this study's sample (i.e., rural, white, females). Rural, food insecure caregivers were the focus of this study because their coping strategies are underrepresented in the literature; however, this simultaneously reduces the study's generalizability to caregivers living in suburban or urban environments. Similarly, it is not known how well the current results would be generalized to households without children, which encompasses approximately half of food insecure households in the United States (USDA Economic Research Service, 2022). In fact, most of the individuals who were excluded from the study did not have a child between the ages of 6 to 12 (79.2%). Therefore, these results cannot necessarily be attributed to rural-food insecure individuals with no children or those with children above/below the study's age range.

Moreover, almost all participating caregivers were women (83.6%), despite the majority living in a household with two caregivers (50.8%). As such, differences in the experiences of male and/or second caregivers with regard to food insecurity, depression, and types of food-based coping strategies could not be assessed in this study. There may be important gender

differences in food insecurity and the use of food-based coping strategies, as previous literature has shown that female-headed households with moderate food insecurity are more successful at mitigating household food insecurity due to the use of more coping strategies as compared to male-headed households (Sanchez-Céspedes, et al., 2022).

The limitations of this study also extend to the online modality that was essential for the baseline and daily data collection in the parent study. Because the data collection occurred over the course of the traditional public-school year in 2021 (March – June and August – December), COVID-19 precautions necessitated the use of online recruitment (Quintana, et al., 2021). Through an online modality of data collection, the study was able to reach more individuals living in rural Vermont, New Hampshire, and New York. Nonetheless, to learn about and participate in the study required caregivers to have access to consistent Wi-Fi and/or cellular service to complete the baseline study visit and daily surveys. This may be problematic for rural communities, where households are 10 times more likely to lack adequate broadband access (download speeds of at least 25 megabits per second) compared to urban households (Federal Communications Commission, 2018). Consequently, the study's sample may not be representative of the entire rural, food-insecure population and families who are most isolated may have been excluded.

Another challenge our study faced was that SNAP benefits and other assistance programs were expanded during the pandemic, which makes it difficult to determine how well findings would generalize to families' experiences outside of the pandemic. More specifically, between October 2020 and September 2021, the Pandemic Electronic Benefit Transfer (P-EBT) program and Farmers to Families Food Box Program were initiated due to the COVID-19 pandemic. Moreover, the USDA's annual nutrition assistance budget nearly doubled the same year,

allowing them to expand their present nutritional aid programs (Toossi, et al., 2022). For instance, the SNAP benefits per household were increased, allowing households that were not already receiving the maximum benefits to receive emergency allotments, regardless of household income. Notably, a rise in both food shortages and food prices were documented during the COVID-19 pandemic due to elevations in food purchases and disruptions in the food supply chain (Wunderlich, 2021). Regarding depression, the prevalence was 3 times higher in the U.S than before the pandemic (Ettman, et al., 2020). Therefore, it is unclear to what degree the relationships between food insecurity, depressive symptoms, and food-based coping strategies differed for caregivers prior to the pandemic.

Another potential limitation of this study was the measure used to identify daily food-based coping strategies. This measure's method of categorization was established based on prior literature, however the data collected came from an open-ended question, which may lead to inconsistent interpretations and responding by different caregivers. As a result, this measure is unstandardized and may be difficult to replicate in future studies. On the other hand, due to the measure being qualitative, more detailed information on coping strategies was revealed that may have not been captured in a multiple-choice question. For example, private management strategies were not identified as a type of food-based coping strategy prior to data collection. As such, the use of a closed-ended question may have diminished the quality of the results.

Implications for Future Research

To date, there has been very little research on the factors that predict specific food-based coping strategies utilized by individuals with food insecurity. Therefore, despite the crucial

information that this study provided regarding factors that drive the use of various coping strategies, more research is needed to investigate these relationships further. First and foremost, it is recommended that this study be revised by addressing the aforementioned limitations. This includes increasing the sample size, standardizing, and validating the assessment of food-based coping strategies. Moreover, it is recommended that a focus be placed on gender differences and individuals from underrepresented communities, following suit of recent work (e.g., Sanchez-Céspedes, et al.,2022).

Another future direction could be comparing the daily food-based coping strategies of rural and urban food insecure caregivers. Food environment was not found to significantly affect any food-based coping strategies; however, the significant positive association between Food Environment Composite, Food Environment Perception, and Adult Food Insecurity found in the correlation analyses suggest that more research needs to be done on this domain. It is possible that the homogeneity of this sample's environment prevented the formation of any significant relationship between food environment and the type of coping strategy utilized. It may be beneficial to compare individuals who live in an environment with limited store options (rural) to those located in an environment with an abundance of stores (urban).

Overall, this study was novel in its investigation of the patterns associated with food-based coping strategies used by food insecure individuals. Future research should further explore severity of food insecurity, food environment, and depressive symptoms in other contexts, such as among caregivers with children younger than 6 years old and older than 12 years old, and adults living in food insecure households without children. It may be that additional burdens are placed on caregivers with young children, increasing the likelihood that they engage in private management strategies like skipping meals. Alternatively, as children get older, aging into

adolescents with greater social awareness and caloric requirements, it may be pertinent to explore their own experiences of food insecurity, food-based coping strategies, and depressive symptoms alongside their caregivers.

It is also recommended that future research focus on shame as a potential mediator to the previously established relationships. In previous literature, shame is highlighted as a factor that influences food-based coping strategies, however, its relations with the severity of daily food insecurity and depressive symptoms framework have not yet been tested. Additionally, shame has been studied extensively using qualitative methods. Future research should conduct quantitative measures of shame to examine shame more accurately in the context of food insecure individuals. Other potential mediators that should be explored include isolative behaviors and the productivity of decision-making. Previous literature suggests that the severity of social isolation and the productivity of caregivers' decisions-making skills may influence the type of food-based coping strategy used; these challenges have not been directly examined in relation to daily food insecurity and depressive symptoms.

CONCLUSION

In summary, the current study identified various daily food-based coping strategies that food insecure caregivers utilize throughout the course of one month. When food insecurity and depressive symptoms are higher, caregivers tend to rely more on private management strategies, which, in the long-term, may exacerbate food insecurity, hunger, and mood difficulties. While further research is needed to elucidate the mechanisms underlying this relationship, it is crucial that programs aimed at alleviating food insecurity take these barriers to engagement into account.

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Tables and Figures

Table 1

Reasons for exclusion from study participation (N=226)

Criteria	N	% excluded
No child between ages 6-12	179	79.2
Food insecurity not endorsed	30	13.3
Not residing in rural area	15	6.6
Lives with child < 75% of time	9	4.0
Not legal caregiver of child	8	3.5
No smartphone	7	3.1
No access to Internet	6	2.7
Less than 18 years old	2	0.9
Unable to speak or read in English	1	0.4

Table 2

Demographic Data of Study Participants (N=61)

	N	Percent (%)		N	Percent (%)
Race and Ethnicity			Subsidized housing	5	8.2
American Indian / Alaska Native	2	3.3	Other not listed above	5	8.2
White / Caucasian	57	93.4	Number of Residents (Including Yourself)		
Prefer not to say	2	3.3	Two	6	9.8
Gender Identity			Three	15	24.6
Cisgender women	51	83.6	Four	15	24.6
Cisgender man	1	1.6	Five	15	24.6
Non-binary / Gender queer	1	1.6	Six or more	8	13.1
Prefer not to say	7	11.5	Number Over 18		
Relationship Status			One	17	27.9
Single, never married	17	27.9	Two	31	50.8
Married / Cohabiting	31	50.8	Three	7	11.5
Widow / Widower	1	1.6	Four	1	1.6
Divorced	6	9.8	Five	1	1.6
Separated	2	3.3	Relationship to Other Adults in Household		
Other not listed	1	1.6	Roommate	3	4.9
Prefer not to say	2	3.3	Spouse	25	41.0
Highest School Degree Attained			Partner	10	16.4
Less than high school	2	3.3	Parent	6	9.8
High school degree / equivalent (e.g GED)	11	18.0	Other not listed above	12	19.7
Some college, no degree	16	26.2	Annual Income Range		
Associate degree	11	18.0	$0-$9,999	5	8.2
Bachelor's degree	8	13.1	$10,000-$19,999	7	11.5
Graduate degree	11	18.0	$20,000-$29,999	16	26.2
Other not listed above	1	1.6	$30,000-$39,999	9	14.8
Employment Status			$40,000-$49,999	9	14.8
Full-time employment	23	37.7	$50,000-$59,999	7	11.5
Self-employed	7	11.5	$60,000-$69,999	2	3.3
Part-time employment	8	13.1	Over $70,000	5	8.2
Unemployment (looking for work)	5	8.3	Household Dietary Restrictions/Sensitivities		
Unemployment (not looking for work)	7	11.7	Lactose intolerant	11	18.0
Student	1	1.7	Dairy avoidant	7	11.5
Unable to work	5	8.3	Gluten intolerant / sensitivity	8	13.1
Other not listed above	4	6.7	Vegetarianism	2	3.3
Current Living Situation			Veganism	1	1.6
Home that I or a family member owns	32	52.5	Ketogenic diet	1	1.6
Rental apartment	18	29.5	Food allergies	10	16.4

Table 3.

Food Assistance Programs Utilized by Participants (N=60)

	N	% utilized
Food Assistance Programs		
Temporary Assistance for Those in Need (TANF)	9	14.8
Supplemental Nutrition Assistance Program (SNAP)	45	73.8
School Lunch and Breakfast Program	50	82.0
Special Supplemental Nutrition Program for Women/Infants/Children (WIC)	40	65.6
National School Lunch Program	20	32.8
Summer Food Service Program (SFSP)	26	42.6
Farm to Family	34	55.7
Other Welfare Programs		
Housing Voucher Program	10	16.4
Energy Assistance	29	47.5
Medicaid, SCHIP, Green Mountain Care	54	88.5
Social Security Benefits	13	21.3
Earned Income Tax Credit	43	70.5
The Child Care Financial Assistance Program	22	36.1
Reach Up	15	24.6
Programs not listed	2	3.3
Summer of Welfare	60	100

Table 4

Means, Standard Deviations, and Correlations among Baseline Measures and Covariates

Variable	M	SD	1	2	3	4	5	6	7	8	9	10
1. Household Food Insecurity	7.78	3.49										
2. Adult Food Insecurity	6.05	2.84	.96**									
3. Physical Functioning	80.36	21.98	-.37**	-.39**								
4. Social Functioning	61.46	31.66	-.33**	-.33**	.44**							
5. Food Environment Composite	6.58	2.90	.46**	.48**	-.19	-.27*						
6. Food Environment perception	13.97	5.19	.47**	.47**	-.24	-.32*	.95**					
7. Anxious Depressed	55.78	7.69	.23	.19	-.15	-.42**	.02	.02				
8. Withdrawn Depressed	54.55	6.53	.22	.22	-.05	-.29*	.10	.04	.65**			
9. Internalizing	52.58	11.0	.36**	.35**	-.22	-.47**	.13	.13	.82**	.74**		
10. Externalizing	48.27	9.66	.25	.21	-.06	-.46**	.10	.14	.69**	.52**	.70**	
11. Food Assistance Programs in Use	3.58	1.34	.29*	.29*	-.40**	-.13	-.06	-.05	.21	.03	.19	.14

Note. * Indicates p<0.05. ** indicates p<0.01

Table 5

Daily Variance of Variables Between and Within Participants

Variable	Random Effects			Fixed Effects		
	Between-Subjects SD	Within-Subjects SD	ICC	Intercept Estimate	Std. Error	t-value
Total daily food insecurity	1.40	1.02	0.65	1.64	0.18	8.99
Felt depressed	0.80	0.78	0.51	1.99	0.10	18.90
Acquired food from a food bank/ kitchen	0.07	0.21	0.10	0.05	0.01	5.03
Borrowed money from friends or family to buy food	0.05	0.18	0.07	0.04	<0.01	4.77
Coped in other ways	0.16	0.26	0.27	0.10	0.02	4.77
Purchased food	0.11	0.46	0.05	0.34	0.02	18.91
Locations (categorized) of food purchase	0.66	2.14	0.09	2.77	0.13	21.63
Applied public coping strategies	0.18	0.40	0.17	0.28	0.05	5.57
Applied private acquisition	0.24	0.40	0.26	0.28	0.06	4.77
Applied private management	0.32	0.37	0.43	0.43	0.07	6.23
Purchase from convenience store	0.11	0.29	0.13	0.10	0.02	5.45
Purchase from grocery store	0.20	0.46	0.16	0.52	0.03	15.41
Purchase from fast food	0.12	0.33	0.12	0.14	0.02	6.76
Purchase from discount store	0.14	0.36	0.13	0.18	0.02	7.72

Note. Location of Food Purchased Scale; 1=grocery store, 2=convenience store, 3=fast food, 4=restaurant, 5=other, 6=free meal, 7=discount store, 8=online retailer

Table 6

Association Between Total Daily Food Insecurity and Food-Based Coping Strategies Utilized

	Dependent Variable		
	Public	**Private Acquisition**	**Private Management**
Intercept			
b	0.30**	0.32**	0.43**
Standard error	0.05	0.06	0.10
Food Insecurity (within)			
b	-0.07**	-0.02	0.07**
Standard error	0.03	0.03	0.02
Food Insecurity (between)			
b	-0.03	-0.08*	0.01*
Standard error	0.03	0.04	0.04

Note: * indicates p< 0.05. ** indicates p<0.01.

Note. * Indicates p<0.05. ** indicates p<0.01

Table 7

Association Between the Food Environment and Food-Based Coping Strategies Utilized

Dependent Variables	Regression Model				Standardized Coefficients (*b*)		
	R^2	df	F-value	p-value	Composite	Perception	Internalizing Problems
Public	0.27	7, 25	1.35	0.27	0.28	-0.48	-0.44*
Private Acquisition	0.10	7, 25	0.42	0.88	-0.56	0.35	-0.23
Private Management	0.22	7, 25	2.7	0.06	0.45	-0.31	0.52*

Note. * Indicates p<0.05. ** indicates p<0.01   df= regression, residual

Table 8

Association Between Depressive Symptoms and Food-Based Coping Strategies Utilized

	Dependent Variable		
	Public	**Private Acquisition**	**Private Management**
Intercept			
b	0.28**	0.29**	0.41**
Standard error	0.05	0.06	0.07
Depressed (within)			
b	0.02	-0.11**	0.08*
Standard error	0.04	0.04	0.04
Depressed (between)			
b	-0.10	<-0.01	0.05
Standard error	0.07	0.08	0.09
Day of Study			
b	<0.01	<0.01	<-0.01*
Standard error	<0.01	<0.01	<0.01

Note. * Indicates p<0.05. ** indicates p<0.01

Table 9

Interaction Effects of Daily Total Food Insecurity and Daily Depressive Symptoms

		Dependent Variable	
	Public	**Private Acquisition**	**Private Management**
Intercept			
b	0.30**	0.33**	0.35**
Standard error	0.05	0.05	0.06
Food Insecurity (within)			
b	-0.07**	-0.02	0.07**
Standard error	0.03	0.03	0.02
Food Insecurity (between)			
b	-0.01	-0.12**	0.13**
Standard error	0.04	0.04	0.05
Depressed (within)			
b	0.03	-0.11**	0.08*
Standard error	0.04	0.04	0.04
Depressed (between)			
b	-0.07	0.11	-0.08
Standard error	0.08	0.08	0.09
Day of Study			
b	<0.01	<0.01	<-0.01
Standard error	<0.01	<0.01	<0.01

Note. * Indicates $p < 0.05$. ** indicates $p < 0.01$