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Food Security, Hunger-coping, and Hunger-Symptoms, and Their Relationship With Daily Fruit and Vegetable Intake Frequency in a Low-income Sample

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Food Security, Hunger-coping, and Hunger-Symptoms, and Their Relationship With Daily Fruit and Vegetable Intake Frequency in a Low-income Sample

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INTRODUCTION

One out of every seven, (14%) households in the United States was food insecure in 2014. This meant that family members did not have access to enough food for an active, healthy life at all times throughout the year.¹ Although some studies have shown an inverse relationship between food security status and fruit and vegetable intake,^{2,3} others have found no association.⁴⁻⁶ The relationship between food security status and dietary patterns is important to address, particularly for low-income, food insecure families. Understanding how this relationship may impact food insecure children is of particular importance, as dietary preferences established in youth have been shown to track into adulthood⁷⁻⁹, and could have implications for policies and programs that target children.

Low-income parents in the United States (US) face many challenges in providing more healthful foods such as fruits and vegetables to their children, such as high cost, limited access, and time constraints. High cost of more healthful foods, both actual and perceived high cost, has been shown to be associated with lower dietary quality¹⁰ and decreased intake of fruits and vegetables by parents and their children.¹¹ In addition, many low-income families live in food deserts without adequate access to healthy, affordable food.¹² These food deserts are often located in economically depressed neighborhoods that lack full service grocery stores. This results in reliance on local convenience stores and fast food outlets. These food outlets tend to stock more energy-dense, nutrient-poor foods, and contain limited, if any, fruits and vegetables.¹³⁻¹⁵ Even when there is sufficient access to more healthful foods, many low-income families consist of a working single parent head-of-household who experience time constraints as a barrier to preparing healthful meals at home.^{16,17} These and many others barriers¹ are often associated with low-income families experiencing food insecurity.

Numerous studies have shown that food assistance programs such as the Supplemental Nutrition Assistance Program (SNAP) play an important role in helping to alleviate food insecurity.^{1,18,19} However, there is a gap in the literature regarding *behaviors* that families may engage in to cope with food insecurity and hunger, and how these behaviors may relate to diet. When experiencing food insecurity, parents may engage in a variety of behaviors to cope with hunger and feed themselves and their family. These hunger-coping strategies can include rationing the food supply by eating less; purchasing fewer fruits and vegetables, which are often perceived as being too expensive; skipping bill payments and other household expenses; and/or acquiring food through less socially desirable

means such as eating discarded food.^{3,20–22} Families' hunger-coping behaviors may affect food purchasing and partially explain effects on diet observed among some food-insecure households.^{2,3} However, these hunger-coping behaviors and any possible associations with diet have not been thoroughly examined, and in particular, how they may relate to child food security and overall health.

The purpose of this study is to separately investigate the relationship between total daily fruit and vegetable intake frequency to five independent variables: 1) food security, 2) a trade-off strategies hunger-coping scale, 3) a financial hunger-coping scale, 4) a rationing hunger-coping scale, and 5) physiological hunger symptoms, among a low-income sample of parents in Omaha, Nebraska.

METHODS

This study utilized a cross-sectional design to collect information as part of a broader evaluation of a collective impact initiative to alleviate childhood hunger in Omaha, Nebraska. Survey participants were recruited over a 5-month period (February-June 2014) from community locations, including public libraries and food pantries, in lower-income areas of interest for the broader initiative. Surveys were administered at the time of recruitment. Because the initiative's focus was on childhood hunger, participants were required to be a parent or caregiver to at least one child aged 0-18 living in the same household at least 50% of the time.

After they were screened for eligibility and provided verbal consent, participants completed a survey that assessed household food security, hunger-coping behaviors and physiological hunger symptoms, fruit and vegetable intake frequency, participation in food and income assistance programs, and sociodemographic and household characteristics. Survey items were extracted, and in some cases were modified, from several existing surveys. New items were also developed; measures are described below. Surveys were predominantly self-administered electronically via tablet to predominantly English speakers.

Survey participants received a \$7 gift card to a large chain superstore for completing the survey. This study was reviewed and approved by the University of Nebraska Medical Center Institutional Review Board.

Measures

Household Food Security. The United States Department of Agriculture (USDA) 6-item Household Food Security Survey Module was used to assess household food security²³ (The 18-item version of the module is

used to produce national-level food security data published by the USDA Economic Research Service). Responses were scored based on the number of affirmative responses (“often true,” “sometimes true,” or “yes”), resulting in a household’s raw food security score on a scale of 0-6.²⁴ Households were stratified into one of four groups: high food security (scores of 0), marginal food security (scores of 1), low food security (2-4), and very low food security (scores of 5-6).

Hunger-Coping Behaviors and Hunger Symptoms. Assessing hunger-coping behaviors (i.e., behaviors that families engage in when they do not have enough food or money for food) is an important way to measure factors that may be associated with food insecurity, but are not captured in the Household Food Security Survey Module. Items to assess hunger-coping behaviors and physiological hunger symptoms were derived from existing literature and modified to be utilized in a survey format.^{20,25–27} Additionally, some new items were developed for inclusion in the survey. The modified and new hunger-coping and hunger symptom items underwent psychometric testing²⁸ and four scales emerged: *trade-off strategies*, *financial*, *rationing*, and *hunger symptoms*. All scales demonstrated acceptable internal consistency (Cronbach’s alpha and Kuder-Richardson (formula 20), ranging from 0.70-0.90) and convergent validity (Spearman’s correlation coefficients ranging from 0.52-0.69, $p < 0.01$).²⁸ Individual scale items are available upon request.

The *trade-off strategies* scale (5 items) asked participants about the choice between paying for food and paying for other necessities. Higher scores indicated use of more trade-off strategies, such as choosing to pay for household, medical, and/or educational expenses over food. Response options were on a 5-point Likert scale (“never” = 1, to “always” = 5).

The *financial coping* scale (5 items) asked participants about strategies they used in the past month to have enough money to buy food and cope with low food resources. Higher scores indicated use of more strategies, such as borrowing money, selling property, skipping bills, or modifying food spending. Response options were dichotomous (“yes” = 1, “no” = 0).

The *rationing coping* scale (5 items) asked participants about stretching food supplies in the past month to cope with low food resources. Higher scores indicated use of more strategies, such as hiding food, eating less food, eating only after children had finished, avoiding preparing food for guests, and overeating when food was available. Response options were dichotomous (“yes” = 1, “no” = 0).

The *hunger symptoms* scale (5 items) asked participants whether they had experienced physiological hunger symptoms in the past month.

Higher scores indicated more experiences of headaches, dizziness, or being moody or tired due to not having enough food to eat. Response options were dichotomous (“yes” = 1, “no” = 0).

Fruit and Vegetable (FV) Intake. The primary outcome variable was total daily FV frequency, measured using five items from the Nutrition Youth Physical Activity and Nutrition Survey (NYPANS) dietary screener (fruit, green salad, carrots, other vegetables, and non-fried potatoes)²⁹, which has previously been used to assess dietary intake in low-income populations.^{30,31} Participants reported consumption for each item by selecting from one of seven frequencies (“did not consume,” “1-3 times per week,” “4-6 times per week,” “1 time per day,” “2 times per day,” “3 times per day,” or “4 or more times per day”). Responses were converted to daily frequencies and summed to create aggregate total daily FV frequency scores. Participants with missing values for any of the five items were excluded. To account for outliers, total daily FV frequency scores that fell three inter-quartile ranges above the third quartile, or three inter-quartile ranges below the first quartile were removed.

Sociodemographic and Household Characteristics.

Sociodemographic and household characteristics assessed included *household size* (< 4 members vs. ≥ 4 members); *employment* (employed vs. not); *food preparation equipment* (has both stove and refrigerator vs. not); *child-to-adult ratio* (≤ 1 vs. > 1); *age* (≤ 39 years old vs. ≥ 40 years old); *income* (≤ \$15,000 vs. > \$15,000); *food pantry use* (weekly or monthly use vs. a few times a year or never); *race/ethnicity* (non-Hispanic black, non-Hispanic white, Hispanic/Latino, and all other races/ethnicities); *marital status* (married or living with partner vs. not); *education* (≤ high school diploma vs. some college or degree); *transportation* (drives own vehicle vs. other); *food assistance* (either Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) or Supplemental Nutrition Assistance Program (SNAP), both, or none); *income assistance* (receiving Social Security Disability Insurance (SSDI), Supplemental Security Income (SSI), and/or Temporary Assistance for Needy Families (TANF) vs. none); and *sex* (male vs. female). For age, income, household size, and child-to-adult ratio, cutoffs were based on sample median.

Analyses

Descriptive statistics, Kruskal-Wallis one-way analysis of variances, and Spearman’s correlations were used to describe the sample and univariate statistical relationships between sociodemographic and household characteristics of the sample, and the main outcome variable in this study, total daily FV frequency.

Generalized linear models were used to assess the relationship between total daily FV frequency and five independent variables: (1) household food security, (2) the trade-off strategies hunger-coping scale (3) the financial hunger-coping scale, (4) the rationing hunger-coping scale and (5) the physiological hunger symptoms scale. To ensure normal distribution of residuals, total daily FV frequency scores were log transformed. Adjusted and unadjusted exponentiated linear regression coefficients ($\exp(\beta)$) were used. Although food security is a categorical variable (high, marginal, low, and very low), “high” food security was used as a referent category in these analyses.

For the adjusted generalized linear models, control variables and interaction terms were selected from the sociodemographic and other sample characteristics using the automated backwards elimination procedure. All potential control variables were first entered into the model along with the dependent variable of interest (i.e., total daily FV frequency). Potential control variables with p-values at or above 0.20 were removed from the model, one at a time, starting with the highest p-value, until all variables in the model had p-values <0.20. P-values of <0.20 were chosen for this model as lower cut points may fail to identify relevant confounders.^{32,33} Next, all interactions between the included control variables were assessed in the same fashion. The final adjusted models include the five independent variables, all control variables, and their interaction terms with p-values <0.20.

Analyses were completed using Statistical Analysis Software (SAS), version 9.4. Alpha level for statistical significance was set at 0.05.

RESULTS

For this study, 278 of 306 participants provided complete data for the primary outcome variable and were included in the analysis. Respondents were predominantly female (73%) and predominantly very low-income, with a majority reporting annual household incomes below \$15,000 (60%). The sample was 45% African-American, 28% Caucasian, 14% Hispanic/Latino, and 12% other racial or ethnic groups. About 65% of respondents had a household size ≤ 4 , and just over half (53%) were unemployed. Two-thirds of respondents (62%) had a high school education or less. Half of respondents (51%) were currently receiving either WIC or SNAP benefits, while a small proportion (13%) was receiving *both* WIC and SNAP assistance. A high percentage of participants fell into the very low food secure category (42%), notable as the 2014 national average is only 6%.¹ Mean FV frequency was 2.40 times per day (SD=1.76).

Table 1 displays results from Kruskal-Wallis tests comparing mean total daily FV frequency with all potential covariates. Households in which the respondent had “some college or degree” had a significantly higher mean daily FV frequency (2.62, SD=1.70, $p<0.05$) than households in which the respondent had a high school diploma or less (2.26, SD=1.78, $p<0.05$).

Table 2 shows results from unadjusted and adjusted generalized linear models for the relationships between the five independent variables (food security, trade-off strategies, financial coping, rationing coping, and hunger symptoms) and daily FV intake frequency. In unadjusted analyses, significant univariate relationships with daily FV frequency were seen for nearly all independent variables. The exception was when comparing across marginal and high food security groups, as well as low and high food security groups.

In adjusted analyses in Table 2, relationships were slightly attenuated, but remained largely significant. Being in the very low food security group, compared to the high food security group, was associated with an expected 26% decrease in daily FV frequency ($\exp(\beta)=0.74$, CI=0.62-0.88, $p<0.05$). Again, there was no significant difference in daily FV frequency between the high and marginal, or high and low, food secure groups. For the hunger symptoms scale, the rationing coping scale, the trade-off strategies scale, and the financial coping scale, a one-point increase in each scale score was associated with an expected decrease in daily FV frequency (hunger symptoms: 5%; rationing coping: 6%; trade-off strategies: 8%; and financial coping: 6%; $\exp(\beta)$'s=0.92-0.95, CI's=0.87-0.98, p 's<0.05).

DISCUSSION

The purpose of this study was to separately investigate the relationship between five independent variables – food security, trade-off strategies, financial coping, rationing coping, and physiological hunger symptoms – and the primary outcome variable, total daily fruit and vegetable frequency. After adjusting for several sociodemographic covariates, households in the very low food secure group, those who engaged in more hunger-coping behaviors, and those who experienced more physiological hunger symptoms had lower reported daily FV intake frequencies. These findings suggest that in addition to food insecurity, other factors such as hunger symptoms and hunger-coping behaviors may be important to assess and address in trying to characterize and intervene on dietary behaviors among low-income populations.

This study surveyed a large proportion of families experiencing low

and very low food security, providing a unique opportunity to assess factors associated with diet in this at-risk population. The very low food secure participants had significantly lower daily FV frequencies than the high food secure participants, while the marginal and low food secure participants had very similar daily FV frequencies that were not significantly lower than the high food secure participants. These findings indicate that food insecure populations may not be a homogenous group,^{34–36} especially with regard to dietary intake. Future studies should look deeper into differences across all four food security classifications and the impacts those differences might have on child diet and associated health outcomes. In particular, hunger-coping behaviors among those in the very low food secure group may be of public health significance and important to address among low-income families. Tarasuk (2001) reported that women who experience acute food shortages and food insecurity were more likely to report behaviors such as delaying bill payment, pawning possessions, or sending children elsewhere for a meal.³⁷

Engaging in hunger-coping behaviors – trade-off strategies, financial coping, and rationing coping – and experiencing physiological hunger symptoms were associated with a decrease in daily FV intake frequency. It is not clear from this study whether these behaviors and experiences led directly to this decrease, or whether they were a marker for food insecurity and/or financial distress. Additionally, some hunger-coping behaviors could be potentially be *protective* against and mediate food insecurity and poor diet, particularly for children, such as parents or caregivers waiting to eat until they've ensured their children have had enough.^{38–40} These relationships and other potentially mediating constructs that have been found to impact this population, including food access, neighborhood safety, opportunities for physical activity, stress, and health care access,⁴¹ could be more closely examined in future studies. Finally, government-administered food assistance programs, such as SNAP and income assistance programs, may also help to mediate the negative effects of hunger and food insecurity. Relationships between participation in these programs and the independent variables in this study could be further explored, particularly for how it may impact children.

There are several limitations to this study. First, although the survey was self-administered and no identifying information was collected, social desirability bias may be a factor due to the sensitive nature of the survey.⁴² Second, this study used cross-sectional data, so is unable to provide evidence of temporal relationships⁴³ between the outcome variable and the five independent variables. Third, this study was conducted with a relatively small sample and in only one, mid-sized city,

which may limit generalizability of the findings. Fourth, although FV frequency was assessed, due to space limitations on the survey, we were not able to assess FV intake or diet more comprehensively (e.g., estimating FV cup equivalents), as well as other “proxy” dietary patterns (e.g., no other healthful or less healthful food items) are included. The ability to estimate FV cup equivalents would allow for comparison against the Dietary Guidelines for Americans⁴⁴ and strengthen the study. Finally, while food security is assessed based on the previous 12-month period, hunger-coping behaviors and hunger symptoms were assessed based on the previous 1-month period, which may ultimately be more sensitive to change, but this has not yet been tested comprehensively. Strengths include the large number of low and very low food secure individuals assessed, and examining FV frequency in relation to both food insecurity as well as hunger-coping behaviors and hunger symptoms, which may ultimately better characterize overall food sufficiency within a household and among families.

CONCLUSION

Interventions, programs, and policies that promote more healthful diets, particularly increased FV intake, could possibly target households who fall into the very low food secure category. Targeting families with the lowest food security maximizes public health impact, and in particular, helps direct services to children in these households who may be disproportionately affected by hunger. Although the 6-item Household Food Security Survey Module does not directly assess the impact on children, children living in very low food secure households may be more likely to experience some or all of the events reported by their parents, such as having to skip meals, cut the size of meals, or eating meals of poor dietary quality. Finally, such interventions, programs and policies should consider concurrently monitoring and measuring hunger-coping behaviors and physiological hunger symptoms in order to build a richer understanding of the experiences faced by food insecure families.

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Table 1. Total mean daily fruit and vegetable (FV) frequency by sociodemographic and household characteristics (n=278)

Variable	Group	n	daily FV frequency (mean)	SD
Whole Sample		278	2.40	1.76
Household size	≤4 members	180	2.42	1.78
	>4 members	98	2.34	1.71
Employment	Unemployed	148	2.38	1.66
	Employed	126	2.43	1.88
Food prep equipment	Stove and refrigerator	249	2.28	1.60
	Only one or none	22	3.01	2.33
Child-to-adult ratio	≤1 Child per adult	163	2.27	1.72
	>1 Child per adult	115	2.57	1.80
Parent age	19 to 39 years old	148	2.56	1.91
	≥ 40 years old	130	2.21	1.54
Household income	≤\$15,000 per year	168	2.20	1.58
	>\$15,000 per year	110	2.69	1.96
Pantry use	Rarely or never	200	2.47	1.78
	Weekly or monthly	78	2.22	1.68
Race/Ethnicity	Black, non-Hispanic	126	2.48	1.82
	White, non-Hispanic	79	2.27	1.49
	Hispanic or Latino	39	2.72	2.02
	All other races/ethnicities	33	2.05	1.77
Marital status	Not married or living with partner	164	2.30	1.70
	Married or living with partner	114	2.53	1.82
Parental education	≤High school diploma	173	2.26	1.78
	Some college or degree	105	2.62*	1.70
Transportation	Drive vehicle	152	2.44	1.71
	Public transportation, friends/family, other	126	2.34	1.81
Food assistance	WIC or SNAP [†]	143	2.31	1.69
	None	99	2.49	1.85
	Both WIC and SNAP	36	2.46	1.79
Income assistance	None	182	2.46	1.84
	Receives SSDI, SSI, and/or TANF [†]	96	2.27	1.58
Sex	Female	202	2.43	1.81
	Male	71	2.36	1.64

*=statistically significant ($p < 0.05$) when two groups

[†]WIC = Special Supplemental Nutrition Program for Women, Infants, and Children; SNAP = Supplemental Nutrition Assistance Program; SSDI = Social Security Disability Insurance; SSI = Supplemental Security Income; TANF = Temporary Assistance for Needy Families

Table 2. Generalized linear models examining the relationship between the five primary independent variables and total daily fruit and vegetable intake frequency

Independent variables	Total daily fruit and vegetable intake frequency	
	Unadjusted exp(β) [†] (95% CI)	Adjusted exp(β) (95% CI)
Food security ^{1,f} (Very Low vs. High)	0.70 (0.60 – 0.83)*	0.74 (0.62 – 0.88)*, ^a
Food security ¹ (Low vs. High)	0.84 (0.70 – 1.00)	0.89 (0.74 – 1.06) ^a
Food security ¹ (Marginal vs. High)	0.84 (0.67 – 1.05)	0.88 (0.70 – 1.10) ^a
Hunger symptoms ^{2,g}	0.94 (0.92 – 0.97)*	0.95 (0.92 – 0.98)*, ^b
Rationing coping ^{2,h}	0.93 (0.90 – 0.97)*	0.94 (0.91 – 0.97)*, ^c
Trade-off strategies ^{2,i}	0.92 (0.87 – 0.97)*	0.92 (0.87 – 0.97)*, ^d
Financial coping ^{2,j}	0.93 (0.90 – 0.97)*	0.94 (0.91 – 0.97)*, ^e

a: controlled for employment status, food preparation equipment, child to adult ratio, income, marital status, education, employment*income, employment*marital status, food preparation equipment*child to adult ratio, food preparation equipment*education, and income*marital status; **b:** controlled for employment status, food preparation equipment, parent age, income, education, employment*income, food preparation equipment*education, age*education; **c:** controlled for employment status, food preparation equipment, parent age, income, education, food preparation equipment*education, age*education; **d:** controlled for employment status, child to adult ratio, income, education, child to adult ratio*education; **e:** controlled for employment status, food preparation equipment, child to adult ratio, income, marital status, education, employment*income, employment*marital status, food preparation equipment*education, and income*marital status
f: n=267; **g:** n=258; **h:** n=258; **i:** n=248; **j:** n=261

1: categorical predictor (with “high” as referent category); **2:** continuous predictor

* = statistically significant ($p < 0.05$)

[†] = exponentiated linear regression coefficient