



Auxiliary measures to assess factors related to food insecurity: Preliminary testing and baseline characteristics of newly designed hunger-coping scales

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ABSTRACT

The objective of this paper is to describe the development and preliminary testing of new scales to assess hunger-coping behaviors in a very low-income population. Very low-income adults (≥ 19 years), caregivers to at least one child ($n = 306$) completed a survey in a community setting (e.g., libraries). The survey included novel items assessing hunger-coping behaviors (e.g., trade-offs to purchase food, strategies to stretch and obtain food), food insecurity status, and physiological hunger. Internal consistency of hunger-coping scales, one-way ANOVAs, post-hoc analyses, Spearman's correlations among variables. Respondents were 75% female, 51% African American, 34% White, and 15% Hispanic, and 73% earned $< \$20,000/\text{year}$. Four scales emerged: *hunger-coping trade-offs*, *financial coping strategies*, *rationing coping strategies*, and *physiological adult hunger symptoms*. All scales demonstrated acceptable internal consistency ($\alpha/\text{KR-20} = 0.70\text{--}0.90$). Predictive, construct, and content validity were demonstrated by correlations between hunger-coping scales and food insecurity (FI), measured with the USDA 6-item HFSSM ($r_s = 0.42\text{--}0.68$, $p_s < 0.001$). Higher levels of *hunger-coping trade-offs* ($F(2,297) = 42.54$, $p < 0.001$), *financial coping strategies* ($F(2,287) = 70.77$, $p < 0.001$), and *rationing coping strategies* ($F(2,284) = 69.19$, $p < 0.001$), corresponded with increasing levels of FI. These preliminary results support use of newly developed hunger-coping scales in a very low-income population and can compliment traditional food security measures to inform hunger prevention policy and programming.

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1. Introduction

One out of every seven (14.3%) households in the United States (U.S.) was food insecure in 2013, meaning members did not have reliable access to sufficient affordable and nutritious food (Coleman-Jensen et al., 2014). A growing body of research shows relationships between food insecurity and poor health and dietary outcomes among certain populations such as adult women and Hispanic families (Cook et al., 2004; Dave et al., 2009; Leung et al., 2012; Olson, 1999; Larson and Story, 2011). Food insecure households are also at risk for poor physiological, cognitive and emotional development and lower overall quality of life (Cook and Frank, 2008; Rose-Jacobs et al., 2008). Accordingly, food insecure populations suffer disproportionately from various chronic diseases (e.g., hypertension, hyperlipidemia, and diabetes) (Seligman et al., 2010).

Food insecurity may be a component related to weight gain and poor health outcomes within the broader environmental, social, and political context of poverty (Finney Rutten et al., 2010). Evidence exists supporting a coexistence of obesity and food insecurity (Adams et al., 2003; Dinour et al., 2007; Townsend et al., 2001; Franklin et al., 2012;

Pan et al., 2012), possibly due to reliance on low-cost foods, which are often energy dense and of poor nutrient quality (Nord and Golla, 2009), although the mechanisms of this relationship are still debated. In order to better understand and develop appropriate interventions for food insecure populations, behavioral mechanisms and potential mediators should be considered (Finney Rutten et al., 2010). The United States Department of Agriculture (USDA) Household Food Security Survey Module (HFSSM) is a widely used 18-item measurement tool that is also available in a shortened, 6-item format (Bickel et al., 2010). While the HFSSM is useful in describing ranges of food security (high, marginal, low, and very low) (United States Department of Agriculture, Economic Research Service, 2014), it does not assess behavioral hunger-coping strategies which may be occurring in food insecure populations. Coping strategies may include behaviors such as rationing food supplies, altering food purchasing habits, and skipping bills, and could subsequently buffer food insecure households from physiological hunger (Finney Rutten et al., 2010; Dietz, 1995).

Few studies have described and assessed potential behavioral coping strategies among the food insecure and have mostly been qualitative in nature. Although some hunger coping items were tested in the 1995

assessment of household food security in the U.S., along with some alternative HFSSM items, these items were not retained since they did not meet statistical criteria for inclusion (Hamilton and Cook, 1997). However, since then, qualitative studies have elaborated on these coping behaviors. One study substantiated coping strategies identified by nutrition educators among low-income audiences through focus groups (Kempson et al., 2003). Another study probed interviewees on 78 similar food acquisition practices and further categorized items into six risk types: financial, food safety, illegal/regulatory, nutritional, physical, and none (Anater et al., 2011). A third study used information gathered in focus groups to survey clients with children at food pantry sites on food coping strategies and related these to different levels of household food security status in a small sample (Wood et al., 2007). These studies have helped lay the theoretical groundwork necessary to conceptualize the novel construct of hunger-coping strategies for the development of the current survey (Kincheloe and McLaren, 2002; Wood et al., 2007). There is a need to develop and preliminarily test complementary measures to the USDA HFSSM, that assess a wider range of behaviors experienced by low-income, food insecure populations.

There is limited research that has examined the development and testing of survey items assessing coping strategies among a low food secure population. The goal of the current study is threefold: (1) to describe the development of a new measure of hunger-coping behaviors; (2) to preliminarily test the new measure of hunger-coping; and (3) to test the relationship of hunger-coping behaviors with food insecurity and physiological hunger. Some of the coping behaviors may be positive, and protective of food insecurity, while others may be more risky, and exacerbate the experience of food insecurity.

2. Methods

Data are from the 2014 [BLIND] Plan, a large three-year multi-component, community-based initiative targeted at reducing hunger. The vision of the [BLIND] Plan is to eliminate hunger in the [BLIND] metro area and is specially aimed to reduce hunger and food insecurity over the three-year period. The overall [BLIND] Plan Survey consisted of 100 items, which assessed various topics such as nutrition assistance program participation, food insecurity, hunger-coping behaviors, hunger symptoms, sociodemographics, and dietary patterns. Items were newly developed, modified, or selected from existing surveys. The survey tools and constructs were developed from untested instruments, qualitative data, and newly developed items. An external expert in the area of food insecurity reviewed the measurement tool and provided input throughout the data collection and analysis. The survey was administered via Apple iPad minis (survey was created electronically using Filemaker Pro (Santa Clara, CA)) ($n = 247$) and pencil-and-paper ($n = 59$) if specifically requested by participants, with English and Spanish versions available. During the first year of the project, the survey was administered to a sample ($n = 306$) of participants recruited from February through June of 2014 in a medium-sized Midwest City. Purposeful sampling occurred at venues in areas where low-income families lived and frequented (e.g., public libraries, food pantries). Eligible participants were 19 years of age and older, a parent or primary caregiver to at least one child (aged 18 or younger) living in the same household 50% of the time or more, and English- or Spanish-speaking. Parents were the targeted sample, given the emphasis on addressing childhood poverty in the [BLIND] Plan. All survey participants received a \$7 gift card to a large chain superstore. Institutional Review Board (IRB) Approval for all components of this data collection was obtained from the [BLIND] IRB.

2.1. Measures

2.1.1. Sociodemographics and family characteristics

Sociodemographics and family characteristics assessed included race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic/

Latino, American Indian, and all other races/ethnicities), age (18–29; 30–39; 40–44; 45–49; 50–64; 65 and older) sex (male vs. female), education (no formal education; grade school; high school or equivalent; vocational, business, or trade school; 2-year junior or community college; 4-year college or university; graduate or professional school), income (none; \$5000 or less; \$5000–\$10,000; \$10,001–\$15,000; \$15,001–\$20,000; \$20,001–\$25,000; \$25,001–\$30,000; \$30,001–\$35,000; \$35,001–\$50,000), Supplemental Nutrition Assistance Program participation (yes vs. no).

2.1.2. Hunger-coping items

New and modified items to assess hunger-coping were developed based on previous qualitative work (Kempson et al., 2003; Anater et al., 2011) and preliminary surveys (Wood et al., 2007). In addition, some items were modified from the Hunger in America Survey, which is conducted every four years with partner agencies in the Feeding America network (Feeding America). Five items included Likert scale responses (1 = never–5 = always) and assessed whether families make sacrifices to afford food (e.g., choosing between paying for food and paying for rent/mortgage). In addition, twenty items included yes/no responses and assessed various behaviors that individuals and families may engage in order to buffer the experience of food insecurity and physiological hunger (e.g., growing food in a garden, limiting intake or locking food up to save it, buying the cheapest food possible).

2.1.3. Physiological hunger symptoms

Finally, six items assessed adult hunger symptoms with yes/no responses to items such as feeling tired or cranky due to lack of food.

2.1.4. Household food security

The USDA HFSSM 6-item module (Bickel et al., 2010) was used to assess food security status and classified households into three categories: High and marginal food security, low food security, and very low food security.

2.2. Analysis

Data were analyzed using SPSS, version 22.0 (SPSS, Inc., Chicago, Illinois). Percentages and mean \pm standard deviations were used to describe hunger-coping items and sociodemographics among all participants. Alpha level for statistical significance was set at 0.05.

Items with Likert-scale responses were tested separately from those with binary response options using Cronbach's alphas for continuous data. Scales were grouped based on theoretical background supporting different types of hunger-coping. Binary response items were further grouped a priori for conceptual relationships, then measured for internal consistency using Kuder-Richardson Formula 20 (KR-20) (Knapp, 1991; Gleason et al., 2010). In order to test preliminary psychometrics, we first tested construct validity through inter-scale correlation of the newly developed scales using Spearman correlations, given non-normal distribution of the data. In addition, content validity was tested with the correlation between the scales and the HFSSM 6-item derived food insecurity level (e.g., high or marginal food security, low food security, and very low food security).

In order to describe differences by level of food security and self-reported hunger-coping and hunger symptom scales, separate one-way analyses of variance (ANOVA) were conducted. Similarly, one-way ANOVAs were conducted to test for food insecurity group differences in adult hunger symptoms (with the same procedures for post-hoc analyses). Tukey's honest significant difference post hoc tests were conducted between each of the following: High or marginal food security versus low food security, high or marginal food security versus very low food security, and low food security versus very low food security to determine significant differences.

3. Results

3.1. Demographics and household characteristics

Table 1 shows the demographic and household characteristics of the sample population, with a large percentage of very low-income participants (e.g., 73% earning less than \$20,000 a year; 2015 federal poverty line for a family of four = \$24,250 <http://aspe.hhs.gov/2015-poverty-guidelines>) and close to 60% participating in the Supplemental Nutrition Assistance Program. Table 1 also shows that respondents were 75% female and about half of the respondents were aged 18 to 39 (53%). The majority of respondents were African American (51%) or White (34%), with some Hispanic respondents (15%). Most of the respondents had a high school or equivalent level of education (56%).

3.2. Scale development and reliability testing (internal consistency) of the scales

Table 2 shows descriptive information of the survey items and internal consistency of various scales. The five items with a Likert response scale were grouped together conceptually as *hunger-coping trade-off strategies*. Internal consistency of this scale was supported by a high

Cronbach's alpha value ($\alpha = 0.85$). Overall, respondents indicated that they engaged in *hunger-coping trade-off* behaviors “sometimes” ($M = 2.12$; $SD = 1.00$) with mean responses to items ranging ($M = 1.75$ – 2.35 out of 5). The hunger-coping item with the highest level of agreement was, “How often during the past month did you or anyone in your household have to choose between paying for food and paying for utilities?” ($M = 2.35$; $SD = 1.28$).

From the binary response items, three scales were identified and tested. There were additional items that did not fit within a scale, these questions are presented as single items for this paper. These included *financial coping strategies* (5 items, yes/no), *rationing coping strategies* (5 items, yes/no), and *physiological hunger symptoms* (6 items, yes/no). An affirmative response indicated participating in the hunger-coping behavior in the past month, and the more affirmative responses, the higher the score for the construct. These two scales demonstrated sufficient internal consistency using KR-20 scores: *financial coping strategies* ($KR-20 = 0.70$; $M = 2.53$; $SD = 1.54$) and *rationing coping strategies* ($KR-20 = 0.74$; $M = 1.92$; $SD = 1.65$). The *financial coping strategies* scale asked respondents whether they have engaged in behaviors such as modifying food purchasing habits or selling or pawning personal property, while the *rationing coping strategies* scale asked respondents whether they have engaged in behaviors, such as eating after children have finished or hiding food to save it (see Table 2 for full list of items, grouped into constructs when applicable). The highest reported *financial coping strategies* were, “bought the cheapest food available” (73.1%) and “avoided buying expensive foods like fruits and vegetables (FVs)” (62.8%). The highest reported *rationing coping strategies* were “eaten as much as possible when food is available” (61.1%) and “eaten meals or snacks after children finished” (52.6%). The mean response to the *financial coping strategies* scale was 2.5 (out of a possible 5), while the mean response to the *rationing coping strategies* scale was 2.1 (out of a possible 5). The remaining ten hunger-coping items that did not fit within a larger scale are described as single items. From the single items, the most common coping strategy that respondents reported doing was “eating food after the expiration date” (43.2%).

The six binary (yes/no) self-reported items that related to adult hunger symptoms had a sufficient KR-20 score to support internal consistency ($KR-20 = 0.90$). The items were worded like, “In the past month have you felt _____ because you did not have money to buy food?”. Respondents indicated that they experienced hunger symptoms at a moderate degree ($M = 2.37$, $SD = 2.38$; Table 2). The hunger symptoms adults reported experiencing most included: feeling their stomach growl due to lack of food (51.7%), feeling cranky due to lack of food (42.1%), and feeling tired due to lack of food (42.2%; Table 2).

3.3. Preliminary validity testing

Construct and content validity were explored through conducting Spearman correlations among variables in the dataset; see Table 3 for correlation matrices. The four hunger-coping scales demonstrated construct validity by being significantly related to each other: *financial coping strategies* and *hunger-coping trade-offs* ($r_s = 0.56$, $p < 0.001$), *financial coping strategies* and *rationing coping strategies* ($r_s = 0.60$, $p < 0.001$), *hunger-coping trade-offs* and *rationing coping strategies* ($r_s = 0.45$, $p < 0.001$), *hunger-symptoms* and *hunger-coping trade-offs* ($r_s = 0.55$, $p < 0.001$), *hunger symptoms* and *financial coping* ($r_s = 0.64$, $p < 0.001$), and *rationing coping* and *hunger symptoms* ($r_s = 0.70$, $p < 0.001$; Table 3). Next, the four hunger-coping scales demonstrated content validity by being significantly related to food security level: *hunger-coping trade-offs* and food security ($r_s = 0.52$, $p < 0.001$), *financial coping strategies* and food security ($r_s = 0.59$, $p < 0.001$), *rationing coping strategies* and food security ($r_s = 0.63$, $p < 0.001$), and *hunger symptoms* and food security ($r_s = 0.69$, $p < 0.001$; Table 3).

Table 1

Socio-demographics and household characteristics among a sample of very low-income survey respondents in Midwest United States ($n = 306$).

Variables	n	%
Sex		
Males	76	25.2
Females	225	74.8
Age		
18–29	63	20.7
30–39	97	31.9
40–44	34	11.2
45–49	41	13.5
50–64	64	21.1
65 and older	5	1.6
Race		
White	94	33.6
African American	143	51.1
American Indian	21	7.5
Pacific Islander	1	0.4
Other	21	7.5
Ethnicity		
Hispanic	44	14.6
Education		
No formal education	5	1.7
Grade school	13	4.3
High school or equivalent	169	55.8
Vocational, business, or trade school	30	9.9
2-year junior or community college	40	13.2
4-year college or university	31	10.2
Graduate or professional school	15	5.0
Household income		
None	50	16.8
\$5000 or less	61	20.5
\$5000–\$10,000	37	12.5
\$10,001–\$15,000	30	10.1
\$15,001–\$20,000	38	12.8
\$20,001–\$25,000	30	10.1
\$25,001–\$30,000	24	8.1
\$30,001–\$35,000	14	4.7
\$35,001–\$50,000	13	4.4
Supplemental Nutrition Assistance Program		
No	123	41.0
Yes	177	59.0
Food security status		
Moderate to high	77	25.4
Low	101	33.3
Very low	125	41.3

Table 2
Descriptives of survey items and internal consistency of scales.

Constructs	Items for measuring construct	M ^c	SD	Cronbach's alpha
Hunger-coping trade-off strategies ^a	Choose between paying for food and paying for...			
	Medicine ^e	2.07	1.22	0.85
	Utilities ^e	2.35	1.28	
	Rent/mortgage ^e	2.05	1.21	
	Transportation ^e	2.26	1.25	
	Education ^e	1.75	1.15	
Total	2.12	1.00		
Constructs	Items for measuring construct	n ^d	%	Kuder-Richardson
Financial coping strategies ^b	Asked friends and family for food or money for food ^f	145	49.0	0.70
	Sold food or pawned any personal property ^e	39	13.1	
	Skipped paying bills to buy food ^f	167	56.2	
	Bought the cheapest food available ^e	215	73.1	
	Avoided buying expensive foods like FVs ^f	187	62.8	
	Mean score = 2.53 (SD = 1.54); 5 items			
Constructs	Items for measuring construct	n ^d	%	Kuder-Richardson
Rationing coping strategies ^b	Locked up or hidden food to save it ^f	49	16.6	0.74
	Stretched food by limiting ^f	130	43.9	
	Avoided having guests to avoid serving food ^f	126	42.7	
	Eaten as much as possible when food is available ^f	115	61.1	
	Eaten meals or snacks after children finished ^g	154	52.6	
	Mean score = 1.92 (SD = 1.65); 5 items			
Constructs	Single items not scaled	n ^d	%	Kuder-Richardson
Hunger-coping items not scaled ^b	Grown food in a garden ^e	53	18.0	N/A
	Eaten meat that you or another person hunted ^e	16	5.4	
	Visited a social or a community event just to eat ^e	86	29.0	
	Eaten "road kill" or animals hit by cars ^e	9	3.0	
	Eaten food that was thrown away ^f	9	3.0	
	Removed slime from lunchmeat before eating ^f	15	5.1	
	Removed mold from cheese or bread before eating ^f	35	11.9	
	Removed spoiled parts from fruits/vegetables ^f	73	24.7	
	Eaten food after the expiration date ^e	127	43.2	
	Watered down infant formula to extend it? ^f	9	11.1	
Constructs	Items for measuring construct ^h	n ^d	%	Kuder-Richardson
Physiological hunger ^b	Growl	149	51.7	0.90
	Dizzy	92	31.4	
	Cranky	125	42.1	
	Tired	124	42.2	
	Headache	107	36.4	
	Sick	100	34.0	
Mean score = 2.37; SD = 2.38; 6 items				

^a N = 300.

^b N = 306.

^c Response scales 1 = never–5 = always in response to "In the past month, how often did you..." (higher means indicate greater use of these coping strategies).

^d Response options were yes/no; therefore, n indicates the number of respondents who agreed they used the coping strategy at least one time in the past month (higher numbers indicate greater use of these coping strategies).

^e Source: Feeding America. Hunger in America 2014. Natl Rep August. 2014.

^f Source: Kempson K, Keenan DP, Sadani PS, Adler A. Maintaining food sufficiency: coping strategies identified by limited-resource individuals versus nutrition educators. *J. Nutr. Educ. Behav.* 2003;35(4):179–88.

^g Newly developed item.

^h Items included the wording "In the past month have you felt ____ because you did not have money to buy food?"

3.4. Financial coping strategies, hunger-coping trade-offs, rationing coping strategies, and hunger symptoms across food insecurity levels

Separate one-way ANOVAs and subsequent post-hoc analyses revealed a positive relationship with reported *hunger-coping trade-offs* ($F(2,297) = 42.54, p < 0.001$), *financial coping strategies* ($F(2,287) = 70.77, p < 0.001$), and *rationing coping strategies* ($F(2,284) = 69.19, p < 0.001$), with increasing levels of food security (Table 4). Tukey's post-hoc analyses revealed significant differences between varying levels of food security and the degree to which *hunger-coping trade-offs*, *rationing coping strategies*, and *financial coping strategies* were

used. With greater levels of food insecurity, there were higher levels of use of hunger-coping strategies.

Similar food security group differences were seen in adult hunger symptoms. One-way ANOVAs revealed that there was a significant difference between adults' experience of hunger symptoms across levels of food security ($F(2,281) = 95.76, p < 0.001$). This was followed by post-hoc analyses that revealed significant differences in adult hunger symptoms existed across high/marginal food security, low food security, very low food security. These analyses demonstrated that with increasing levels of food insecurity, self-reported adult hunger symptoms also increased.

Table 3
Spearman correlation matrix for content validity and construct validity.

		Hunger-coping trade-offs	Financial coping strategies	Rationing coping strategies	Hunger symptoms	Food security level
Hunger-coping trade-offs	rs	1	0.556**	0.451**	0.548**	0.518**
	p-Value	–	0.000	0.000	0.000	0.000
	N	300	290	287	284	300
Financial coping strategies	rs	0.556**	1	0.600**	0.641**	0.590**
	p-Value	0.000	–	0.000	0.000	0.000
	N	290	290	279	277	290
Rationing coping strategies	rs	0.451**	0.600**	1	0.701**	0.627**
	p-Value	0.000	0.000	–	0.000	0.000
	N	287	279	287	275	287
Hunger symptoms	rs	0.548**	0.641**	0.701**	1	0.690**
	p-Value	0.000	0.000	0.000	–	0.000
	N	284	277	275	284	284
Food security level	rs	0.518**	0.590**	0.627**	0.690**	1
	p-Value	0.000	0.000	0.000	0.000	–
	N	300	290	287	284	302

** $p < 0.01$.

4. Discussion

This study pilot-tested modified and newly developed survey items that assessed hunger-coping strategies and respondent-reported physiological hunger symptoms among a sample of very low-income residents living in a medium-sized city in the Midwest. These new constructs were also assessed for associations with three levels of food security as measured by the USDA HFSSM 6-item module. Since the Food Security Module assesses food insecurity at the household-level, it is mainly an economically-driven construct (e.g., assessing affordability, cost or having enough money for food, etc.), and does not adequately capture other potential factors associated with food insecurity, such as individual behavioral factors (Webb et al., 2006). A recent review examined food insecurity measures internationally and reported that many measures are lacking in detail and do not capture the trade-offs that families have to make when choosing to pay for food versus other items (Cafiero et al., 2014). The authors of the review determined that experience-based food insecurity measures were ones that captured factors beyond dietary intake and were described as promising tools that can be applied in conjunction with other indicators to better understand the determinants and consequences of household and individual food insecurity (Cafiero et al., 2014).

The current study was unique in delving further into exploring, developing, and testing preliminarily other potentially important constructs related to food insecurity, including hunger-coping behaviors and the experience of physiological hunger in a largely low-income and food insecure population. Furthermore, results from survey data, such as results from the current study, are easier to generalize, and can help overcome limitations of qualitative methodology (e.g., interviews) surrounding food, as parents may feel conflicted or ashamed about their circumstances and less likely to share information candidly in an interview format (Campbell and Desjardins, 1989; Kelley et al., 2003). Preliminary testing supported four scales: *hunger-coping-trade-offs*, *rationing coping strategies*, *financial coping strategies*, and

physiological hunger. These four scales all demonstrated sufficient internal consistency as well as construct, content, and predictive validity. Since there is currently a dearth of “auxiliary” measures in the food insecurity literature, this fills a critical gap and could be helpful to other researchers and practitioners. Particular coping behaviors measured with the current tool may be positive, and protective of food insecurity, while others may be more risky, and exacerbate the experience of food insecurity. Future studies may want to utilize a larger, more representative sample (i.e., national) in order to conduct a factor analysis that would allow for correlations among the items to determine which subscales are present. In addition, further psychometric testing can be conducted with various study designs, including test-retest reliability, concurrent validity, and predictive validity.

In this mainly low-income sample, respondents who reported experiencing household food insecurity were likely to employ more hunger-coping behaviors. For example, one of the most commonly reported coping strategies was to avoid buying expensive foods like fruits and vegetables (63% of respondents). Similarly, Hoisington and colleagues reported focus group participants describing food stretching strategies, such as selecting lower cost fruits and vegetables (e.g., canned) (Hoisington et al., 2002). Another study showed that low-income consumers considered price when making choices about foods to purchase (Steenhuis et al., 2011), making calorie-dense, nutrient-poor foods more appealing to purchase (Drewnowski, 2004; Waterlander et al., 2010; Jezovit, 2011). Finally, another study that explored assessing food insecurity and perceived barriers to accessing adequate nutrition through a survey in a large sample found that similar coping behaviors were significantly related to the experience of food insecurity (e.g., trade-offs with other costs like health care and housing) (Tolzman, 2013). Together, these findings suggest that low-income and food insecure households are potentially displaced by the current state of our food system in the United States, which makes calorie-dense, nutrient-poor foods more affordable, while also making more healthful foods (such as fruits and vegetables) relatively less affordable

Table 4
Analysis of variance measuring the relationship among coping behaviors and hunger symptoms across food security levels (n = 286–299).

	High or marginal food security (n = 70) [†]		Low food security (n = 93)		Very low food security (n = 116)	
	Mean	SD	Mean	SD	Mean	SD
Hunger-coping trade-off strategies	1.41	0.67*	2.06	0.98*	2.60	0.90*
Rationing coping	0.24	0.25*	0.49	0.28*	0.68	0.22*
Financial coping	0.12	0.18*	0.34	0.30*	0.59	0.29*
Adult hunger symptoms	0.05	0.17*	0.30	0.34*	0.67	0.34*

* Post hoc tests revealed significant differences on these measures between all three levels of food security, significance $p < 0.05$.[†] Post-hoc tests revealed significant differences only between high/marginal food security and very low food security levels.

(Yaroch and Pinard, 2012; Story et al., 2008; Putnam et al., 2002; Aggarwal et al., 2012).

In this study, respondents who reported experiencing household food insecurity at greater levels were also more likely to experience hunger symptoms. Respondents also reported a tendency towards eating as much as possible when food was available. This phenomenon has been observed among food insecure populations where bingeing behaviors are followed by episodic periods of hunger (Urbszat et al., 2002; Polivy, 1996). With increasing levels of food insecurity and hunger, families are more likely to utilize coping strategies. However, hunger-coping constructs have not been typically included in measurement and interventions and should be considered for use, especially in being able to better describe and intervene on a population that is often understudied and not well understood. Perhaps by utilizing an expanded model of food insecurity and hunger, we can also better understand the complexities of these issues, including the paradoxical relationship between hunger and obesity (Adams et al., 2003; Dinour et al., 2007; Townsend et al., 2001; Franklin et al., 2012; Pan et al., 2012), and intervene on behaviors that may be contributing to, or protecting against, poor dietary and health outcomes.

Some caution is required in interpreting our results, as they are based on a purposeful sample of low-income respondents drawn from various community locations (e.g., food pantries, libraries) in a medium-sized Midwest city, which may have resulted in a sample that is not representative of the broader low-income food insecure population across the U.S., especially when compared to random sampling. In addition, the majority of respondents were younger adults with at least one child living in their home, thus results may not generalize to an older adult population, and should be explored in future studies. A larger, more representative sample would allow for more robust psychometric testing and more formal exploration of constructs with factor analysis or item response theory. The cross-sectional nature of the data gathered and inherent bias in self-reported measures are a further limitation. Due to the cross-sectional nature of the data, we could not determine test-retest reliability, or predictive validity. However, it does give glimpse into or snapshot of an often under assessed population of low and very low food secure households. The scales were self-reported, and the physiological hunger scale may be particularly limited given the difficulty to self-report and capture this experience with validity. Future research may want to explore this aspect of food insecurity in a laboratory or more controlled setting. Although cognitive testing is important to ascertain a clearer understanding of what survey items are measuring from the perspective of respondents (Alaimo et al., 1999), it was not possible within the scope of this study. Given the novelty of assessing hunger-coping variables, the developed survey had not previously been tested in a low-income sample; however, the results yielded preliminary support for its comprehensibility, and further testing is planned in the future.

This study adds to our understanding of an at-risk and understudied population by helping to explain how families may utilize coping strategies when experiencing hunger and food insecurity. Building from existing qualitative (Kempson et al., 2003; Anater et al., 2011) and quantitative (Wood et al., 2007; Laraia et al., 2006) studies, the hunger-coping constructs in the current study were comprised of items collected and new ones developed based on the breadth of current evidence related to food insecurity, coping behaviors, physiological hunger, and related potential negative outcomes.

Strengths of the current study include the exploration into differentiating between physiological hunger and food insecurity as distinct constructs among very low-income individuals. We recommend that commonly used coping strategies should be integrated into nutrition education and anti-hunger initiatives. It has been shown that further tailoring approaches to better address needs may result in greater impact on targeted outcomes (e.g., reducing hunger) (Noar et al., 2007; Campbell and Quintiliani, 2006). In addition, by delineating different coping strategies, we can better understand intricacies and potential

importance of some strategies versus others (e.g., avoid buying expensive foods vs. watering down infant formula) and subsequently, appropriate strategies could be developed and employed in anti-hunger programs or interventions.

4.1. Conclusions and implications

Overall, this study reports unique baseline results and preliminary testing that will inform the following two years of data collection that are planned as part of a multi-component, community-wide study that aims to reduce hunger and food insecurity. Future research may seek to integrate potentially important factors, such as hunger-coping when addressing food insecurity. Results using measures that assess a broader range of behaviors and coping mechanisms in food insecure populations can inform policy and program implementation that addresses fundamental needs and complex issues.

Conflicts of interest

The authors declare that there are no conflicts of interest.

Transparency document

The [Transparency document](#) associated with this article can be found, in the online version.

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