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### **The Effect of Food Price on Food Insecurity and Diet Quality: Exploring Potential Moderating Roles of SNAP and Consumer Competency**

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## **Abstract**

Higher food prices may aggravate household food insecurity and hurt diet quality. Using a sample of low-income households from the National Household Food Acquisition and Purchase Survey (FoodAPS), this study examines whether local food prices affect food insecurity and nutritional quality of foods acquired, and how households use competent consumer behaviors to mitigate any adverse effects of price. Financial management practices, nutrition literacy, and conscientious food shopping practices were considered for consumer competency. Our findings indicate that low-income households in higher-cost areas, regardless of whether they participate in SNAP or not, are more likely to adopt loyalty or other store savings programs than those in areas where food cost is relatively lower. Also, controlling for local food cost and various household characteristics, SNAP participants are more likely to use loyalty programs or other store savings, and are more likely to be aware of the dietary guidelines than nonparticipants. Our findings suggest that, although theoretically households could benefit from various consumer competencies and skills especially when the food cost is high, taking advantage of competent consumption strategies may be out of reach for many low-income consumers dealing with high food cost. Further, policies that incentivize competent or conscientious consumption among program participants might decrease food insecurity but likely at the expense of lowered nutritional quality of acquired foods, as long as less healthy food choices are also less expensive.

## **Executive summary**

*Introduction:* Households living in high food price areas are more likely to suffer food insecurity (Gregory & Coleman-Jensen, 2013) and may also be priced out of healthy food options. This study takes advantage of detailed food acquisition and purchase records and geographic indicators in the FoodAPS data to explore whether local food price affects low-income households' risk of food insecurity as well as nutritional quality of foods acquired, and how households that are faced with high food cost in the area use competent consumption behaviors to maintain food security and diet quality.

*Methods:* To assess whether low-income households in high food price areas are more likely to display competent consumption behaviors, dichotomous variables of behaviors representing consumer competency are regressed over the local-level food price, along with various household characteristics as controls. Because price varies across the year and was measured for the given time period during which each household's food acquisition was recorded, time-specific fixed effect term is included. To see if SNAP participants and nonparticipants respond differently to high cost of food, an interaction term is included. Logit models were estimated. To examine whether consumer competency alleviates the adverse effect of high food cost on nutritional outcomes, food insecurity and diet quality variables were each regressed over local basket price, consumer competency indicators, SNAP participation, household characteristics, and week fixed effects.

*Data:* The study uses data from the USDA's National Household Food Acquisition and Purchase Survey (FoodAPS). A sample of 1,908 households, who had incomes below 185% of the federal poverty level and reported at least one event of grocery shopping during the seven-day reporting period were used for analysis. The food insecurity status was determined based on the 30-day adult food security survey module. A series of nutritional quality measures were computed by aggregating food component and nutrient information of all food items acquired by the household during the seven-day reporting period. Indicators for three areas of consumer competency pertinent to food purchase, including financial competency, nutrition literacy, and conscientious buying, were constructed based on survey responses as

well as records of food acquisition events. Four alternate measures of local cost of aggregate food categories comprising Thrifty Food Plan (TFP) were obtained from the geographic component (FoodAPS-GC) and matched to household level data based on location of the household and the timing (week) of the survey.

*Results:* The results indicate that basket price were negatively associated with financial management practices, shopping with a grocery list, coupon use, and using nutrition facts labels, after controlling for the household characteristics, food environment, and the weekly fixed effects. On the other hand, high food cost in the area was strongly correlated with households' increased use of loyalty programs or other store savings. While we suspect the disturbing negative associations largely reflect endogeneity or reverse causality, we find that these negative associations between food cost and consumer competency were not as pronounced among SNAP participants as they were with nonparticipants. Controlling for consumer competency, we find little evidence that food cost affects the risk of food insecurity. local food cost lowers the whole-grain content of the acquired foods, but it also significantly lowers sodium density of acquired foods.

*Discussion:* Our findings indicate that low-income households in higher-cost areas, regardless of whether they participate in SNAP or not, are more likely to adopt loyalty or other store savings programs than those in areas where food cost is relatively lower. Also, controlling for local food cost and various household characteristics, SNAP participants are more likely to use loyalty programs or other store savings, and are more likely to be aware of the dietary guidelines than nonparticipants.

*Conclusion:* Our findings suggest that, although theoretically households could benefit from various consumer competencies and skills especially when the food cost is high, taking advantage of competent consumption strategies may be out of reach for many low-income consumers dealing with high food cost. Further, policies that incentivize competent or conscientious consumption among program participants might decrease food insecurity but likely at the expense of lowered nutritional quality of acquired foods, as long as less healthy food choices are also less expensive.

## **Introduction**

Households living in high food price areas are more likely to suffer food insecurity (Gregory & Coleman-Jensen, 2013) and may also be priced out of healthy food options. This study takes advantage of detailed food acquisition and purchase records and geographic indicators in the FoodAPS data to explore whether local food price affects low-income households' risk of food insecurity as well as nutritional quality of foods acquired, and how households that are faced with high food cost in the area use competent consumption behaviors to maintain food security and diet quality.

Millions of Americans are challenged with food insecurity -- a condition of insufficient access to food due to resource constraint. In 2014, 14% of U.S. households (17.4 million households) were food insecure (Coleman-Jensen, Rabbitt, Gregory, & Singh, 2015). Whereas recent studies found that SNAP participation decreases food insecurity (Borjas, 2004; Li, Mills, Davis, & Mykerezi, 2014; Nord & Golla, 2009; Shaefer & Gutierrez, 2013), the rate of food insecurity among SNAP participants is still high (Nord, Coleman-Jensen, Andrews, & Carlson, 2010). Although food insecurity is a condition strongly associated with poverty and income volatility (Loopstra & Tarasuk, 2013), income alone may be an imperfect predictor of food insecurity. Research has found that households' competency as consumers may help them avoid food insecurity. Low-to-moderate-income households who had better financial management practices or greater financial literacy were less likely to be food insecure than others (Gaines, Robb, Knol, & Sickler, 2014; Gundersen & Garasky, 2012; Millimet, McDonough, & Fomby, 2015). Other skills and behaviors such as food budgeting, food shopping, and food resource management have also been linked to adequate food access (Kaiser et al., 2015; Lohse, Belue, Smith, Wamboldt, & Cunningham-Sabo, 2015).

Besides food insecurity, improving the dietary quality of low-income population is another goal of food assistance programs such as SNAP (Bitler, 2014). Poor diet quality is often associated with food insecurity; however, food insecurity may not directly determine poor diet quality (Bhattacharya, Currie, & Haider, 2004). Faced with high food price, households with limited resources may use various coping

strategies to acquire healthful foods. Existing literature identified various consumer competencies that relate to improved dietary intake. Not only that eating competence, nutrition knowledge, and health literacy were associated with dietary intake (Lohse, Bailey, Krall, Wall, & Mitchell, 2012; Spronk, Kullen, Burdon, & O'Connor, 2014; Wardle, Parmenter, & Waller, 2000; Zoellner et al., 2011), perceived consumer effectiveness and food shopping practices such as label use or shopping with a grocery list have been found to predict better dietary quality especially among low-income individuals (Dubowitz, Cohen, Huang, Beckman, & Collins, 2015; Hersey et al., 2001; Kim, Nayga, & Capps, 2000; Vermeir & Verbeke, 2006; Wiig & Smith, 2009).

Although many research findings provided evidence that consumer competency is an important determinant of food security and diet quality and implied an argument for incorporating resource management skills in the nutrition education curricula for program participants such as SNAP-ED, more knowledge of the role of consumer competency in improving food insecurity and nutrition among limited-resource households is desired for at least two reasons. First, current understanding of the role of consumer competency is based on studies that each investigated the relationship between a particular aspect of consumer competency and its targeted nutritional outcome. Little is known about how consumer strategies to secure a sufficient *quantity* of foods (e.g., money-saving, budget-stretching techniques) are associated with the nutritional *quality* of foods consumed, or how households' abilities and efforts to acquire and consume healthful foods may affect their food insecurity. Second, the vast majority of existing research regarding consumer competency and shopping behaviors relied on local data or limited geographic scope and therefore lacked the ability to observe whether households in high cost areas are more likely to display competent consumer behaviors than those in low cost areas. More needs to be known regarding how the cost of food affects nutritional quality of foods consumed by low-income households, and how this potential effect of food cost interacts with consumer competency. If households use coping strategies such as competent consumer behavior in response to high food cost, a crude estimate of the effect of food cost on food security and nutritional outcomes or the effects of consumer

competency might be an underestimation.

This study extends the literature by considering a wide array of consumer competencies and explores how they are associated with both food security and nutritional quality of foods that low-income households buy. It also examines whether low-income households in higher-cost areas are more likely to engage in competent consumer behaviors to counteract the price disadvantage. This study also examines whether SNAP participants are different from nonparticipants in terms of consumer competency. If SNAP participants are less competent, it should be examined whether SNAP replaces desirable behaviors or it's just that different people choose different strategies – between program reliance and consumer competency.

### *Consumer Competency*

Consumers' skills and abilities in managing resources can avoid food insecurity. These include financial management, food resource management, and nutrition literacy. A few recent studies argue that nutrition education for low-income audience should incorporate food resource management (e.g., food budgeting and food shopping), to help them best manage their food dollars to afford healthy food (Kaiser et al., 2015; Lohse et al., 2015; Wiig & Smith, 2008). Improving food resource management skills through effective nutrition education programs could enhance food security of low-income households (Kaiser et al. 2015; Lohse et al., 2015). Additionally, nutrition literacy, “the degree to which individuals have the capacity to obtain, process, and understand nutrition information and skills needed to make appropriate nutrition decisions” has been linked to nutrition outcomes such as diet quality (Zoellner, Connell, Bounds, et al., 2009). Health literacy is associated with healthy eating as well as sugar-sweetened beverage intake (Zoellner et al., 2011). While nutrition is a key part of health literacy, other studies examined nutrition knowledge and its relationship with diet quality (Spronk et al., 2014). With the comprehensive literature review, Spronk et al. found the association between nutrition knowledge and dietary intake most often a higher intake of fruit and vegetables. However, they noted the heterogeneity in

assessing nutrition knowledge and dietary quality (Spronk et al., 2014). Additionally, food shopping practice has been associated with dietary quality of low income women (Hersey et al., 2001). Worrying about money for food is negatively associated with eating competence (Lohse, et al., 2012). Therefore, nutrition education for low-income individuals often includes food shopping and food resource management in order to enhance the nutrition quality.

A substantial number of low-income families already engage in various thrifty food shopping practices (Dachner, Ricciuto, Kirpatrick, & Tarasuk, 2010; Hersey, et al., 2001). However, despite the efforts to maximize food dollars, many households could not afford to purchase enough healthy diet (Dachner et al., 2010). Moreover, Kaiser et al. (2015) found that improvement in resource management skills was associated with reduced food insecurity only among participants who received SNAP benefits. They suggest that both SNAP participation and education on food resource management are needed to reduce food insecurity (Kaiser et al., 2015). The effects of consumer competency may vary by the resources, including SNAP, which low-income households may have access to. The results will provide policy implications with more complete knowledge of how “consumer competency” serves as tools for low-income households in dealing with food insecurity and diet quality.

Utilizing the data from the newly available USDA’s National Household Food Acquisition and Purchase Survey (FoodAPS), this study examines the roles of SNAP and consumer competency such as financial management, nutrition literacy, and conscientious food shopping in household food insecurity and nutritional quality of acquired foods.

### *SNAP*

Estimating the impacts of SNAP in addressing food insecurity has been challenged with endogeneity or selection bias (Gundersen et al., 2011; Li, Mills, Davis, & Mykerezi, 2014; Shafer & Gutierrez, 2013). With attempts to address this issue, However, unobserved differences between food insecure and food secure households have been noted. Further the impact of SNAP on nutrition quality



has been more complicated. Low-income families are faced with overwhelming challenge feeding the family at low cost. Low-cost energy dense foods are often one strategy to choose and prepare food family to ensure no one in family goes hungry (Basiotis, Kramer-LeBlanc, & Kennedy, 1998; Drewnowski, 2004). Evidence of how SNAP affects diet quality has been mixed.

Estimated effects range from modest improvement in healthy food consumption to contributing to unhealthy diet and obesity (Bitler, 2014; DeBono, Ross, Berrang-Ford, 2012; Gregory, Ver Ploeg, Andrews, & Coleman-Jensen, 2012; Whitmore, 2002; Zagorsky & Smith, 2009). Overall, research on the nutrition effects of SNAP has been challenged with selection bias.

### *Other Factors*

Food insecurity is a public concern due to adverse health outcomes. Food insecurity has been associated with race/ethnicity, marital status, education, age, home ownership, presence of children, income, asset ownership, and others (Gundersen, Kreider & Pepper, 2011). Individuals' health and diet conditions have bidirectional relationship with food insecurity. Furthermore, food access and food environment has been considered as a causal factor of behaviors related to nutrition and health (McKinnon et al., 2009). Participation in other assistance programs such as WIC or National School Lunch Program was also found to ameliorate food insecurity.

## **Methods**

To assess whether low-income households in high food price areas are more likely to display competent consumption behaviors, dichotomous variables of behaviors representing consumer competency are regressed over the local-level food price, along with various household characteristics as controls. That is,

$$C_{ij}^* = \alpha_1 Price_{jt} + \alpha_2 SNAP_{ij} + X_{ij}'\alpha_3 + \gamma_t$$

where  $C^*$  is the latent values of consumer competency,  $Price$  is the local average cost of a standard food

basket in US dollars, SNAP is a dichotomous variable for the household's SNAP participation,  $\mathbf{X}$  is a vector of household characteristics, and  $i, j$ , and  $t$  index households, geographic location, and time, respectively. Because price varies across the year and was measured for the given time period during which each household's food acquisition was recorded, time-specific fixed effect term is included. The regression coefficients  $\alpha_{1...3}$  are estimated in Logit models. If high food price makes households use more competent consumption behaviors,  $\alpha_1$  will be positive. We also estimate this with state policy and administrative indicators as instrumental variables for SNAP to assess the causal effect of SNAP participation on consumer competency.

To see if SNAP participants and nonparticipants respond differently to high cost of food, the above equation is modified to include an interaction term:

$$C_{ij}^* = \alpha_1 Price_{jt} + \alpha_2 SNAP_{ij} + \alpha_3 SNAP_{ij} * Price_j + \mathbf{X}_{ij}' \alpha_4 + \gamma_t.$$

The coefficient  $\alpha_3$  is expected be negative if SNAP participants are less likely than nonparticipants to respond to high cost of food.

Our main research objectives include whether consumer competency alleviates the adverse effect of high food cost on nutritional outcomes, namely food security and nutritional quality of acquired food. We first estimate the relationship between food cost and the outcome measures:

$$Y_{ij}^* = \beta_1 Price_{jt} + C_{ij}' \beta_2 + \beta_3 SNAP_{ij} + \mathbf{X}_{ij}' \beta_4 + \gamma_t$$

For the food insecurity equation,  $Y^*$  denotes the latent variable of food insecurity, so that  $Y=1$  if  $Y^*>0$ , and  $Y=0$  otherwise; and the coefficients are estimated with Logit models. For the outcome of nutritional quality, this equation is estimated in linear regressions. The coefficient  $\beta_2$  denotes the association between consumer competency and the outcome measures. We estimate this regression model with and without the consumer competency term, so that the change in the coefficient  $\beta_1$  would assess the mediating role of competency.

## **Data**

The study uses data from the USDA's National Household Food Acquisition and Purchase Survey (FoodAPS). The FoodAPS is a survey of a nationally representative sample of households on their food acquisition. The data contain detailed records of the participating households' food acquisition activities during the seven-day reporting period including groceries as well as foods eaten outside the home by household members. The data also include in-depth interviews of households' main food shoppers or meal planners about usual food acquisition behavior, places of food acquisition, expenditures, food security status, nutrition knowledge, program participation, and socio-demographic information. Based on the seven-day food acquisition record, the amount and types of foods and nutrients acquired were also computed. Among household main data files, we use the household file, individual file, food-at-home event file, and food-at-home nutrient file. The FoodAPS files store some of this information at levels as specific as food acquisition event or individual food item, which we summarize at the household level before merging. We also extract food price and other relevant food environmental information from the FoodAPS's Geography Component data files. These geographic files are merged to household main data using the household geocodes data file.

Of 4,826 participating households, we excluded 581 households that did not report any grocery shopping during the seven-day reporting period or reported buying only one food item of zero calorie. Additional 122 households had missing values in key variables and 216 households had no price data, and had to be dropped. The sample was further reduced to those with incomes below 185% of the federal poverty level (FPL). After dropping these observations, a total of 1,908 households comprised our final sample for analysis. Sampling weights were applied to represent the given population.

### *Variables*

#### *Food Insecurity*

The food insecurity status was determined by the interview data using the 30-day adult food

security module developed by the USDA's Economic Research Service. Following the USDA definition, households were classified into four categories: food security, marginal food security, low food security, and very low food security based on the number of affirmative responses. This study defines the dichotomous variable of food insecurity as belonging to either low or very low food security. We also use the dichotomous variable of very low food security as an additional outcome measure. The FoodAPS did not measure child food insecurity, but given not all households have children, adult food insecurity may be a fair and comparable measure for the entire sample.

### *Nutritional Quality of Acquired Foods*

We construct a series of nutritional quality measures at the household level by aggregating food component and nutrient information of all food items acquired by the household during the seven-day reporting period. The quality of acquired food used as a proxy for diet quality is justified by the literature that found *home availability* is among the strongest correlates of food intake (Neumark-Stzainer et al, 2003; Story et al, 2008). However, compared to food-intake diaries, food acquisition records may have three or more limitations in representing one's diet quality. First, acquisition is at the household-level, thus individual-level food consumption is unknown. Despite our control for household size and composition, intra-household distribution of foods and nutrients remains unknown. Second, it is uncertain to the researchers over what period the acquired food was consumed (e.g., a box of dry pasta might be consumed over several months in one household and in one night in another household). Without knowing each household's frequency of food acquisition, we attempt to maximize accuracy by controlling for household size, usual dine-out frequency, and presence of recent meal guests. We also believe that the items that are consumed over a longer period are purchased less frequently, and therefore averages may still be accurate. Third, the portion of the acquired foods that gets consumed or if the food is consumed at all is also unknown (e.g., a half bag of fresh vegetable might be thrown away uneaten). Lack of information for food waste introduces a potential bias because food acquisition data will likely overstate consumption of perishable fresh foods more than consumption of nonperishable processed foods. One

shortcoming of this study is we only analyze foods to be consumed at home because food-away-from-home nutrient data are unavailable at this point.

### *SNAP*

Participation in SNAP is coded as 1 if anyone in the household currently receives SNAP benefits, and 0 otherwise. In the FoodAPS, this variable was created based on survey responses and confirmed by the system match to the SNAP administrative database.

### *Consumer Competency*

This study investigates three competency areas pertinent to food purchase, including financial competency, nutrition literacy, and conscientious buying.

Three variables of financial competency were created. First, *Financial Management* is a continuous variable, which is a mean of responses to four questions: “how often household reviews bills for accuracy”, “how often household pays bills on time”, “how often household pays more than minimum payment”, and household’s reported financial condition. Each of these was recorded on a 5-point scale, with greater values meaning better management. Second, *No Default* is a dichotomous variable indicating the respondent disagreed to all three statements: “could not pay rent/mortgage, utility, or important medical bill within last 6 months”, “evicted for not paying rent/mortgage within last 6 months”, and “could not pay full amount of utility bills within last 6 months”. If the household experienced any of these within the last 6 months of the survey, the variable was coded 0. Third, *No Loan* variable is a dichotomous measure indicating the household has not taken any credit card cash advance or payday-like loans within last 6 months. Defaulting payments or taking out short-term loans can signify unsound financial practices, or it can simply be a reflection of hardship. Therefore, we also estimate models with the financial management variable only, without these two variables.

Several survey questions were combined to create three dichotomous variables indicating

nutrition literacy. They are: respondent has heard of dietary guidelines, such as MyPlate or MyPyramid (*Know Guideline*); respondent attempts to follow MyPlate or MyPyramid recommendations (*Follow Guideline*); and respondent uses the nutrition facts panel on food product packaging most of the time or always (*Use Panel*).

In addition to financial literacy and nutrition literacy, conscientious or frugal buying behavior can imply competency in consumption. In this study we use three indicators: whether they shop with a grocery list at least most of the time (*Grocery List*), whether they used any coupons (*Coupons*), and whether they used any other types of store savings (*Store Savings*). Whereas *Grocery List* was based on a questionnaire item about usual behavior, the variables *Coupons* and *Store Savings* were based on actual use reported or observed in the food acquisition events during the seven-day reporting period.

### *Food Cost*

Local cost of aggregate food categories comprising Thrifty Food Plan (TFP) was obtained from the geographic component (FoodAPS-GC) and matched to household level data based on location of the household and the timing (week) of the survey. Cost of food was measured at two different geographic levels – (i) average market basket price of participating retailers in the given county, and (ii) average market basket price of participating retailers that are within 20 miles of the Census block group centroid. Also, the cost was assessed as average of the *median* basket price at each of the stores, and an average of the *low-cost* basket price.

## **Results**

### *Descriptive Statistics*

The descriptive statistics from table 1 indicate that a significantly higher portion of respondents who reported being food insecure (49%) and very food insecure (22%) were SNAP participants as compared to those who were food insecure (28%) and very food insecure (13%) but did not participate in

SNAP. A significantly higher percentage of respondents who consumed ‘solid fats, alcohol, and added sugar’ (SoFAAS) also reported being SNAP (40%) when compared to those who did not participate in SNAP (36%). Additionally, a higher percentage of individuals who reported good financial management practices were SNAP participants. Among those respondents who shopped with a grocery list 49% were not SNAP participants while 39% were SNAP participants.

The additional summary statistics are shown in table 2. The SNAP participants on average are younger in age (46) than the non-SNAP participants (54). Among all participants under 185% of FPL, a higher percentage among the Black (26%) and Hispanic (23%) respondents were SNAP participants as compared to the Black (14%) and Hispanic (19%) respondents who were not SNAP participants. Among respondents with educational attainment of high school or lower a higher percentage were SNAP participants, while for respondents with educational attainment of higher than high school a higher percentage were non-SNAP participants. Similarly, higher percentages among respondents who were single or never married, or were divorced were SNAP participants, whereas a higher percentage among respondents who were either married or widowed was non-SNAP participants. Among respondents with a child in school 40% were SNAP participants, whereas 25% were non-SNAP participants. A higher percentage of homeowners and vehicle owners were non-SNAP participants, while a lower percentage of homeowners and vehicle owners were SNAP participants. Among those who reported poor health approximately 50% were SNAP participants while 31% were non-SNAP participants.

#### *Financial Management Practices: Implications for Food Price*

Table 3A shows the results of the logistic regression analysis with the different financial management variables assigned as the dependent variables. The results indicate that county average median basket price and block group average median basket price were negatively associated with the likelihood of paying bills on time after controlling for the household characteristics, food environment, and the weekly fixed effects. Similarly block group average median basket price was also positively

associated with the participants' likelihood of making more than minimum payments on revolving debt both before and after controlling for the household characteristics, food environment, and the weekly fixed effects.

#### *Conscientious Buying and Nutrition Literacy: Implications of Food Price*

Table 3B shows the results of the logistic regression analysis with the different conscientious shopping practices assigned as dependent variables. The results indicate that county average median and low cost basket price variables, and the block group average median and block group average low cost basket variables were negatively associated with shopping using a grocery list both before and after controlling for the household characteristics, food environment, and the weekly fixed effects. Similarly, the county average median and low cost basket prices were negatively associated with the participants' use of coupons when shopping for food when the household characteristics, food environment, and the weekly fixed effects were included in the model. Interestingly, the county average median and low cost basket price variables, and the block group average median and block group average low cost basket variables were positively associated with consumers' using loyalty or other stores savings cards both before and after controlling for the household characteristics, food environment, and the weekly fixed effects. Conversely, the county average median basket price was negatively associated with the use of nutrition facts labels by the respondents.

#### *Financial Management Practices: Implications of Food Price and SNAP*

Table 4A shows the results of the logistic regression analyses for the various financial management practices after controlling for the SNAP participation. The model also controls for the county and block level average median and low cost basket variables, the household characteristics, food environment, and the weekly fixed effects. The results indicate that when the model includes SNAP participation and the county level average median variable and the interaction of the two, SNAP participation is negatively associated with being in good financial condition, but the significance of this



variable goes away once the household characteristics, food environment, and the weekly fixed effects are included in the model. Similarly, the county average median basket and SNAP participation was negatively associated with reviewing the bill once a purchase has been done. The SNAP variable, however, was not significant once the household characteristics, food environment, and the weekly fixed effects were included in the model. Similarly, SNAP participation was also negatively associated with the other desirable financial management practices such as paying bills on time, paying more than the minimum requirement on revolving credit, and non-participation in payday loans. The block group average median basket was negatively associated with being in good financial condition, reviewing bills, paying bills on time, and not participating in payday loans. However, these differences went away once the household characteristics, food environment, and the weekly fixed effects were included in the model. The interaction of SNAP participation and block group average median price was positively associated with reviewing bills and non-participation in the payday loan markets.

#### *Conscientious Buying and Nutrition Literacy: Implications of Food Price and SNAP*

Tables 4B shows the results of the logistic regression analyses for the various conscientious buying practices and SNAP participation. The model also controls for the county and block level average median and low cost basket variables, the household characteristics, food environment, and the weekly fixed effects. The results indicate that when the model includes SNAP participation and the county level average median basket price variable and the interaction of the two, SNAP participation is negatively associated in shopping with a grocery list, the county level average median basket price is also significant and negatively associated with shopping with a grocery list. However, the interaction term of SNAP participation and county average median basket price was positively associated with having a grocery list when shopping even after controlling for the household characteristics, food environment, and weekly fixed effects in the model, and for following guideline when the household characteristics, food environment, and weekly fixed effects were not included in the model. Similarly, the county average median basket was negatively associated with using coupons, but positively associated with loyalty

programs or store savings when the household characteristics, food environment, and weekly fixed effects were not included in the model.

Similarly, in the logistic regression models un with county average low-cost basket, SNAP, and the interaction term of these two variables, the results indicate that the county average low-cost basket variable was negatively associated with having a grocery list when shopping across both the models that separately controlled for the weekly trend, and household characteristics, food environment, and weekly fixed effects. The use of loyalty or other store savings was negatively associated with the county average low-cost basket variable only when the household characteristics, food environment, and weekly fixed effects variables were included in the model. Conversely, the county average low-cost basket variable was positively associated with the use of loyalty or store savings, and guideline knowledge. SNAP participation was also negatively associated with having a grocery list when shopping, but positively associated with the use of loyalty or other store savings, and guideline knowledge. However, the interaction term of these two variables was positively associated with having a grocery list when shopping, and negatively associated with knowledge of nutrition guidelines. The interaction variable of SNAP participation and country average low cost basket was also negatively associated with use of loyalty or other savings when household characteristics, food environment, and weekly fixed effects were not included in the model.

The logistic regression models run with Block group level average median basket, SNAP participation, and the interaction of these two variables show that Block group average median basket price and SNAP participation were negatively associated with having a grocery list when shopping, but positively associated with the use of loyalty or other store savings. The SNAP participation variable was also negatively associated with the use of nutrition fact labels when shopping when household characteristics, food environment, and weekly fixed effects were not included in the model. The interaction term of SNAP participation and Block group median average basket was positively associated with having a grocery list when shopping, and negatively associated with the use of loyalty discounts or

other store savings.

Correspondingly, the logistic regression models that included Block group level low-cost basket, SNAP participation, and the interaction of these two variables show that Block group average low-cost basket was negatively associated with having a grocery list when shopping in the model when shopping when household characteristics, food environment, and weekly fixed effects were not included in the model. But it was positively associated with the use of loyalty or other store savings. The SNAP participation variable was also positively associated with the use of loyalty discounts or other stores savings, and the knowledge of nutrition guideline. The interaction term of SNAP participation and Block group low-cost basket average was negatively associated with the use of loyalty discounts or other store savings and knowledge of the guideline.

#### *Food Insecurity: Implications of Food Price and Consumer Competency*

The logistic regression results examining the association for the county and block level food basket prices, and consumer competency related factors on food insecurity after controlling for the household level characteristics, food environment, and weekly fixed effects is shown in table 5. The results indicate that participants who perceived being in good financial condition were less likely to be food insecure. Similarly, paying bills on time, making more than minimum payments on revolving debt, and not defaulting on loans were negatively associated with food insecurity after controlling for factors related to household characteristics, food environment, and the weekly fixed effects.

#### *Nutrition Quality of Acquired food: Implications of Food Price and Consumer Competency*

The linear regression results for the association between nutrition quality factors such as energy density, fruit density, whole fruit density, and whole grain density are shown in table 6A. The independent variables include county average median basket and the consumer competency variables. The model also controls for household characteristics, food environment, and the weekly fixed effects. The results indicate that perception of being in good financial condition was positively associated with

consumption of foods that have high energy density and whole grain density. County average median basket price was negatively associated with the intake of foods with whole grain density. Use of loyalty discounts or other store savings and the use of nutrition facts labels were also positively associated with the intake of food with higher whole grain density.

The linear regression results for the nutrition quality variables: vegetable density, sodium density, and SoFAAS density are shown in table 6B. The results indicate that respondents who did not participate in cash advance or payday loans were positively associated with the consumption of food with greater vegetable density. Conversely, the use of loyalty or store savings discounts was negatively associated with the consumption of meals high in vegetable density. County average median price basket and paying more than minimum on revolving debt, and use of nutrition labels when shopping were negatively associated with the amount of sodium density consumed in meals. The perception of being in good financial condition and not defaulting on debt were negatively associated with the consumption of the percentage of SoFAAS consumed in meals.

### **Discussion**

Our findings show that high food cost is negatively associated with certain behaviors indicating consumer competency in low-income households. Households living in the areas with higher local food cost, regardless of the four different methods chosen to define high cost, were less likely to engage in review bills regularly, pay bills on time, use grocery list, use coupons, or use nutrition facts labels. However, high food cost in the area was strongly correlated with households' increased use of loyalty programs or other store savings.

While we suspect the disturbing negative associations largely reflect endogeneity or reverse causality, we find that these negative associations between food cost and consumer competency were not as pronounced among SNAP participants compared to nonparticipants. For example, SNAP participants in high cost areas were more likely than nonparticipants or participants in low cost areas to review bills

regularly, avoid high-interest financial services such as cash advance or payday loans, shop with a grocery list, and follow dietary guidelines when faced with higher food cost. It is also noteworthy that, controlling for local food cost, SNAP participants were more likely to use loyalty programs or other store savings, and more likely to be aware of the dietary guidelines than nonparticipants.

Controlling for consumer competency, other household characteristics, and food environment of the community, we find little evidence that food cost affects the risk of food insecurity. Controlling for various household and community characteristics, households that engage in better financial management practices were less likely to be food insecure. Again, we are not sure how much of it is due to causal effects and how much is due to endogeneity. Households' use of other competent behaviors such as nutrition literacy or thrifty food shopping was not significantly associated with the risk of food insecurity.

Controlling for consumer competency, household characteristics, and food environment of the community, local food cost lowers the whole-grain content of the acquired foods, but it also significantly lowers sodium density of acquired foods.

Certain consumer competency items were associated with higher nutritional quality of acquired foods. Avoiding cash advance or payday loans was associated with greater vegetable density, paying bills more than the required minimum was associated with lower sodium and empty calorie densities. Use of loyalty or other store savings was positively associated with whole grain density, but negatively associated with buying vegetables. Those who frequently use nutrition facts labels acquired foods with greater whole grain contents, and foods with less with sodium or empty calorie.

## **Conclusion**

Our findings indicate that the relationship between food price and nutritional outcomes can be complex. Although at least theoretically households could benefit from various consumer competencies and skills especially when the food cost is high, taking advantage of competent consumption strategies may be out of reach for many low-income consumers dealing with high food cost. One thrifty shopping

strategy we find low-income consumers diligently use in coping with high cost of food is participation in loyalty programs or other store savings. Low-income households in higher-cost areas, SNAP participants and nonparticipants alike, are more likely to adopt loyalty or other store savings programs than those in areas where food cost is relatively lower.

Our findings also suggest different areas of consumer competency have different roles in relation to food security and nutritional quality of acquired foods. Financial management was found to be associated with low food insecurity but its correlation with nutritional quality is weak and mixed. On the other hand, nutrition literacy was significantly associated with positive nutritional quality of acquired foods but not with food insecurity. For low-income households, purchasing enough food to avoid hunger and acquiring nutritious foods may be competing needs, especially when healthful foods cost more than unhealthy ones. We find that, although conscientious shopping strategies were actively used among low-income households to stretch food dollars to purchase enough food for the family, they did not necessarily translate into improved nutritional quality of acquired foods, and sometimes rather decreased nutritional quality. This may indicate that those who are more strained for resources may be more likely to utilize conscientious shopping strategies than others. Their priorities may be to avoid their family from going hungry, meaning purchasing low-cost, energy-dense food.

Our current study has several limitations. First, the local food cost is likely to be correlated with cost of living in general, which our model did not consider. Second, food away from home was not included in our measures of nutritional quality of acquired foods. Third, the relationships between food price, consumer competency, and nutrition outcomes we measure are based on correlations and cannot be interpreted as cause-and-effect.

Policy focus on consumer competency programs in SNAP might help achieving program goals at the margin but the effect may be modest due to the economic strain challenging many consumption categories for low-income households. Our findings suggest policies that incentivize competent or

conscientious consumption among program participants might decrease food insecurity but likely at the expense of lowered nutritional quality, as long as less healthy food choices are also less expensive.

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Table 1

## Summary Statistics: Key Variables

	All <185% (N=1,923)	SNAP (N=1,011)	Non-SNAP (N=912)	t
Food Insecurity <sup>A</sup>	.360 (.481)	.491 (.500)	.279 (.449)	7.04***
Very Low Food Security <sup>A</sup>	.166 (.372)	.224 (.417)	.131 (.337)	4.27***
Fruit density	.346 (.744)	.317 (.769)	.364 (.729)	-1.00
Whole fruit density	.285 (.728)	.256 (.751)	.303 (.713)	-0.96
Whole grain density	.424 (.932)	.357 (.642)	.465 (1.070)	-1.36
Vegetable density	.574 (1.581)	.494 (1.446)	.623 (1.657)	-1.10
Energy density	1.414 (.821)	1.336 (.764)	1.461 (.852)	-1.87†
Sodium density	1840 (6945)	1815 (7625)	1856 (6497)	-0.12
SoFAAS percent	37.5 (21.9)	40.4 (21.9)	35.8 (21.8)	3.60***
<b>Financial Management</b>				
In good financial condition <sup>A</sup>	.320 (.466)	.186 (.390)	.403 (.491)	-7.50***
Review bills usually <sup>A</sup>	.685 (.464)	.641 (.480)	.713 (.453)	-2.91**
Pay bills on time usually <sup>A</sup>	.803 (.398)	.687 (.464)	.874 (.332)	-8.45***
Pay more than minimum usually <sup>A</sup>	.265 (.441)	.127 (.333)	.350 (.477)	-5.71***
No financial delinquency <sup>A</sup>	.693 (.461)	.543 (.498)	.786 (.411)	-9.32***
No cash advance or payday loan <sup>A</sup>	.921 (.269)	.899 (.302)	.936 (.246)	-2.19*
<b>Conscientious Consumption</b>				
Shop with grocery list usually <sup>A</sup>	.451 (.498)	.387 (.487)	.490 (.500)	-2.48*
Use coupons <sup>A</sup>	.225 (.418)	.216 (.412)	.230 (.421)	-0.58
Use loyalty or other store savings <sup>A</sup>	.552 (.497)	.566 (.496)	.543 (.498)	0.71
<b>Nutrition Literacy</b>				
Guideline knowledge <sup>A</sup>	.551 (.498)	.581 (.494)	.532 (.499)	1.06
Follow guideline <sup>A</sup>	.212 (.409)	.243 (.429)	.192 (.394)	1.37
Use nutrition facts labels usually <sup>A</sup>	.323 (.468)	.301 (.459)	.337 (.473)	-1.33
<b>Basket Price</b>				
County average median basket price	281.2 (39.0)	278.4 (36.5)	282.9 (40.4)	-1.54
County average low-cost basket price	149.0 (20.4)	147.7 (18.7)	149.8 (21.4)	-1.17
Block group average median basket price	280.3 (44.9)	280.4 (44.5)	280.3 (45.2)	0.06
Block group average low-cost basket price	148.4 (21.5)	148.4 (22.2)	148.4 (21.0)	0.02

Notes: Means and standard deviations adjusted for survey weights. <sup>A</sup> dichotomous variables. † p<.10, \* p<.05, \*\* p<.01, \*\*\* p<.001

Table 2

## Summary Statistics: Demographic, Program Participation, Dietary Needs, and Environmental Variables

	All <185% (N=1,923)	SNAP (N=1,011)	Non-SNAP (N=912)
Age	51.2 (17.8)	46.3 (15.8)	54.2 (18.3)
Gender <sup>A</sup>	.443 (.497)	.476 (.500)	.423 (.494)
Race: White <sup>A</sup>	.693 (.461)	.605 (.489)	.748 (.434)
Race: Black <sup>A</sup>	.186 (.389)	.256 (.437)	.143 (.351)
Race: Asian <sup>A</sup>	--- (---)	--- (---)	--- (---)
Race: Other <sup>A</sup>	.100 (.300)	.132 (.338)	.081 (.273)
Hispanic <sup>A</sup>	.204 (.403)	.232 (.422)	.186 (.390)
Education: Less than HS <sup>A</sup>	.227 (.419)	.293 (.455)	.186 (.389)
Education: High school <sup>A</sup>	.353 (.478)	.358 (.480)	.349 (.477)
Education: Some college <sup>A</sup>	.202 (.402)	.189 (.391)	.211 (.408)
Education: Bachelors <sup>A</sup>	.083 (.276)	.061 (.239)	.097 (.296)
Education: Postgraduate <sup>A</sup>	--- (---)	--- (---)	--- (---)
Marital: Married <sup>A</sup>	.280 (.449)	.208 (.406)	.324 (.468)
Marital: Widowed <sup>A</sup>	.137 (.344)	.094 (.292)	.164 (.370)
Marital: Divorced or separated <sup>A</sup>	.315 (.464)	.341 (.474)	.298 (.459)
Marital: Never married <sup>A</sup>	.269 (.443)	.357 (.479)	.214 (.411)
Child in school <sup>A</sup>	.305 (.461)	.402 (.490)	.246 (.431)
Household size	2.5 (1.8)	2.8 (1.9)	2.3 (1.8)
Employed <sup>A</sup>	.384 (.486)	.347 (.476)	.406 (.491)
Income (\$/m)	1552.3 (985.9)	1310.0 (975.1)	1701.5 (963.0)
Home tenure	12.4 (14.5)	9.5 (12.7)	14.2 (15.2)
Home ownership <sup>A</sup>	.417 (.493)	.271 (.444)	.507 (.500)
Vehicle ownership <sup>A</sup>	.746 (.435)	.649 (.478)	.806 (.396)
WIC <sup>A</sup>	.082 (.275)	.141 (.348)	.046 (.210)
NSLP/NSBP <sup>A</sup>	.248 (.432)	.361 (.481)	.178 (.382)
Special dietary needs <sup>A</sup>	.531 (.499)	.558 (.497)	.514 (.500)
Poor health <sup>A</sup>	.382 (.486)	.498 (.500)	.310 (.463)
#Dinners out per week <sup>A</sup>	1.2 (1.3)	1.1 (1.2)	1.2 (1.3)
Urban tract <sup>A</sup>	.682 (.466)	.720 (.449)	.659 (.474)
Miles to nearest supermarket from BG center	2.5 (3.5)	2.2 (3.3)	2.6 (3.7)
Low access tract (1 mile for urban, 20 miles for rural) <sup>A</sup>	.259 (.438)	.261 (.440)	.257 (.437)
Food exempt from state sales tax <sup>A</sup>	.929 (.256)	.956 (.204)	.913 (.282)
State food tax rate (%)	.476 (1.328)	.333 (1.085)	.564 (1.451)

Notes: Means and standard deviations adjusted for survey weights. <sup>A</sup> dichotomous variables.

Table 3A

## Logit Regressions of Financial Management Practices: Implications of Food Price (N=1,923)

	In good financial condition		Review bills		Pay bills on time		Pay more than minimum		No defaulting		No cash advance or payday loan	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
County average median basket price	-.0011 (.0032)	-.0037 (.0031)	-.0023 (.0014)	-.0003 (.0015)	-.0045 (.0033)	-.0081* (.0038)	.0042 (.0027)	.0028 (.0023)	-.0020 (.0027)	-.0028 (.0031)	-.0033 (.0030)	-.0035 (.0034)
County average low-cost basket price	.0029 (.0035)	.0010 (.0036)	-.0032 (.0024)	-.0013 (.0025)	.0012 (.0047)	-.0018 (.0065)	.0005 (.0054)	.0005 (.0032)	-.0003 (.0043)	-.0007 (.0054)	-.0046 (.0055)	-.0047 (.0063)
Block group average median basket price	-.0001 (.0017)	-.0010 (.0024)	-.0019 (.0016)	-.0005 (.0015)	-.0032 (.0024)	-.0042† (.0024)	.0057** (.0018)	.0054* (.0020)	.0010 (.0015)	.0011 (.0019)	-.0009 (.0024)	-.0011 (.0025)
Block group average low-cost basket price	.0005 (.0030)	.0007 (.0044)	-.0045 (.0035)	-.0022 (.0036)	-.0022 (.0046)	.0024 (.0054)	.0029 (.0042)	.0043 (.0034)	.0012 (.0030)	.0034 (.0034)	-.0029 (.0040)	-.0014 (.0044)
Weekly trend	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Household characteristics	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Food environment	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Weekly fixed effects	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes

Notes: Weighted Logit regression coefficients and linearized standard errors. Each of the four price measures was estimated in separate regressions. † p<.10, \* p<.05, \*\* p<.01, \*\*\* p<.001

Table 3B

Logit Regressions of Conscientious Buying and Nutrition Literacy: Implications of Food Price (N=1,923)

	Shop with grocery list		Use coupons		Use loyalty or other store savings		Guideline knowledge		Follow guideline		Use nutrition facts labels	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
County average median basket price	-.0041*	-.0046*	-.0015	-.0045†	.0092***	.0110***	.0013	-.0015	-.0014	-.0018	-.0007	-.0037†
	(.0017)	(.0017)	(.0025)	(.0024)	(.0023)	(.0019)	(.0020)	(.0026)	(.0020)	(.0023)	(.0022)	(.0021)
County average low-cost basket price	-.0089**	-.0117**	-.0019	-.0062†	.0172**	.0186**	.0056	.0002	-.0014	-.0021	.0002	-.0024
	(.0029)	(.0030)	(.0032)	(.0036)	(.0053)	(.0055)	(.0038)	(.0039)	(.0034)	(.0046)	(.0038)	(.0041)
Block group average median basket price	-.0038*	-.0029†	-.0001	-.0020	.0063***	.0078**	.0013	-.0018	.0007	-.0005	.0002	-.0005
	(.0015)	(.0014)	(.0020)	(.0023)	(.0016)	(.0021)	(.0015)	(.0013)	(.0017)	(.0021)	(.0013)	(.0016)
Block group average low-cost basket price	-.0084*	-.0072**	.0025	-.0017	.0125**	.0140**	.0043	-.0024	.0002	-.0022	.0010	.0002
	(.0031)	(.0023)	(.0035)	(.0039)	(.0042)	(.0042)	(.0037)	(.0028)	(.0035)	(.0040)	(.0027)	(.0032)
Weekly trend	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Household characteristics	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Food environment	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Weekly fixed effects	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes

Notes: Weighted Logit regression coefficients and linearized standard errors. Each of the four price measures was estimated in separate regressions. † p<.10, \* p<.05, \*\* p<.01, \*\*\* p<.001

Table 4A

## Logit Regressions of Financial Management Practices: Implications of Food Price and SNAP

	In good financial condition		Review bills		Pay bills on time		Pay more than minimum		No defaulting		No cash advance or payday loan	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
County average median basket	-.002 (.003)	-.004 (.003)	-.005** (.002)	-.004† (.002)	-.007 (.005)	-.008 (.005)	.003 (.003)	.002 (.003)	-.003 (.003)	-.003 (.004)	-.008 (.005)	-.007 (.005)
SNAP*County median basket	.003 (.003)	.003 (.003)	.006 (.004)	.005 (.004)	.004 (.004)	.001 (.004)	.006 (.005)	.005 (.004)	.000 (.003)	.001 (.004)	.010 (.007)	.009 (.007)
SNAP	-1.839† (.977)	-1.572 (.965)	-1.907† (1.064)	-1.322 (1.055)	-2.247* (1.052)	-1.137 (1.016)	-3.261* (1.392)	-2.286† (1.179)	-1.236 (.862)	-.944 (1.093)	-3.283† (1.871)	-2.659 (1.878)
County average low-cost basket	.003 (.005)	.003 (.005)	-.005 (.004)	-.003 (.004)	-.002 (.006)	-.001 (.008)	-.003 (.006)	-.001 (.004)	-.002 (.006)	-.001 (.007)	-.005 (.009)	-.003 (.010)
SNAP*County low cost basket	-.007 (.006)	-.007 (.008)	.004 (.005)	.003 (.006)	.003 (.006)	-.001 (.005)	.008 (.010)	.006 (.010)	.002 (.006)	.001 (.005)	-.001 (.010)	-.001 (.011)
SNAP	-.155 (.934)	.383 (1.075)	-.923 (.740)	-.337 (.913)	-1.661† (.856)	-.679 (.780)	-2.627† (1.505)	-1.849 (1.469)	-1.420 (.906)	-.887 (.827)	-.463 (1.523)	-.014 (1.665)
Block group average median basket	-.003* (.002)	-.003 (.002)	-.005** (.002)	-.003 (.002)	-.006† (.003)	-.005 (.003)	.002 (.002)	.003 (.002)	-.003 (.002)	-.002 (.002)	-.009* (.004)	-.006 (.004)
SNAP*Block group median	.002 (.003)	.002 (.003)	.006* (.003)	.005† (.003)	.001 (.003)	-.001 (.003)	-.000 (.004)	-.001 (.004)	.002 (.003)	.004 (.004)	.011* (.005)	.011† (.006)
SNAP	-1.611* (.748)	-1.251 (.823)	-1.966* (.750)	-1.353† (.709)	-1.597† (.865)	-.535 (.818)	-1.339 (1.205)	-.850 (1.134)	-1.825* (.851)	-1.715 (1.092)	-3.577* (1.398)	-3.319† (1.648)
Block group average low-cost basket	-.004 (.005)	-.002 (.006)	-.006 (.004)	.001 (.004)	-.006 (.006)	-.000 (.006)	-.002 (.006)	.001 (.005)	-.005 (.004)	-.001 (.005)	-.009 (.008)	-.004 (.009)
SNAP*block group low cost basket	-.004 (.008)	-.003 (.008)	.005 (.005)	.004 (.006)	.000 (.005)	-.005 (.006)	-.002 (.011)	-.000 (.010)	.004 (.006)	.005 (.006)	.002 (.010)	.001 (.012)
SNAP	-.575 (1.176)	-.325 (1.099)	-1.101 (.803)	-.467 (.946)	-1.232 (.837)	-.076 (.896)	-1.093 (1.763)	-1.001 (1.559)	-1.709* (.834)	-1.351 (1.109)	-.902 (1.491)	-.431 (1.766)

Notes: Weighted Logit regression coefficients and linearized standard errors. Each of the four price measures was estimated in separate regressions. † p<.10, \* p<.05, \*\* p<.01, \*\*\* p<.001

Table 4B

## Logit Regressions of Conscientious Buying and Nutrition Literacy: Implications of Food Price and SNAP

	Shop with grocery list		Use coupons		Use loyalty or other store savings		Guideline knowledge		Follow guideline		Use nutrition facts labels	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
County average median basket	-.009**	-.010***	-.004	-.007*	.011***	.012	.002	-.000	-.004	-.004	-.001	-.004
	(.003)	(.002)	(.003)	(.003)	(.003)	(.002)	(.003)	(.003)	(.004)	(.003)	(.003)	(.003)
SNAP*County median basket	.012**	.013**	.005	.006	-.004	-.004	.001	-.001	.008†	.006	.001	-.000
	(.004)	(.004)	(.005)	(.005)	(.004)	(.003)	(.005)	(.005)	(.005)	(.005)	(.004)	(.004)
SNAP	-3.668**	-3.753**	-1.430	-1.639	1.351	1.647	-.100	.480	-2.042	-1.503	-.372	-.050
	(1.114)	(1.205)	(1.608)	(1.634)	(1.083)	(.985)	(1.378)	(1.283)	(1.261)	(1.366)	(1.050)	(1.228)
County average low-cost basket	-.015***	-.018***	-.005	-.010†	.021***	.022***	.012*	.008*	-.003	-.003	-.002	-.003
	(.004)	(.004)	(.005)	(.005)	(.005)	(.006)	(.005)	(.004)	(.006)	(.007)	(.005)	(.005)
SNAP*County low cost basket	.016**	.019**	.009	.009	-.010*	-.009	-.015**	-.018**	.009	.007	.001	-.001
	(.005)	(.006)	(.008)	(.009)	(.005)	(.006)	(.005)	(.005)	(.010)	(.012)	(.007)	(.008)
SNAP	-2.826**	-2.986**	-1.409	-1.277	1.562*	1.772†	2.469**	2.916***	-1.120	-.722	-.406	.091
	(.823)	(.923)	(1.363)	(1.462)	(.682)	(.890)	(.745)	(.735)	(1.537)	(1.774)	(1.072)	(1.203)
Block group average median basket	-.006*	-.005*	-.001	-.003	.007**	.009***	.003	.001	-.002	-.003	-.002	-.002
	(.002)	(.002)	(.002)	(.003)	(.002)	(.002)	(.003)	(.002)	(.002)	(.003)	(.002)	(.002)
SNAP*Block group median	.006†	.006†	.000	.002	-.005†	-.006*	-.002	-.004	.006†	.006	.005	.004
	(.003)	(.003)	(.004)	(.004)	(.003)	(.003)	(.003)	(.003)	(.003)	(.004)	(.003)	(.003)
SNAP	-2.054*	-1.902*	-.221	-.549	1.475*	2.084**	.722	1.352	-1.462	-1.394	-1.500†	-1.273
	(.953)	(.917)	(1.216)	(1.265)	(.724)	(.755)	(.994)	(.910)	(.949)	(1.217)	(.874)	(.921)
Block group average low-cost basket	-.008†	-.005	.001	-.004	.016***	.020***	.010	.004	-.003	-.004	-.006	-.006
	(.004)	(.003)	(.004)	(.005)	(.005)	(.004)	(.006)	(.005)	(.006)	(.007)	(.005)	(.004)
SNAP*block group low cost basket	.002	.003	-.001	.004	-.012*	-.013*	-.015†	-.018*	.007	.008	.009	.008
	(.005)	(.005)	(.007)	(.008)	(.005)	(.006)	(.008)	(.008)	(.010)	(.011)	(.008)	(.009)
SNAP	-.645	-.661	.072	-.518	1.812*	2.259**	2.352*	2.798*	-.743	-.942	-1.477	-1.307
	(.808)	(.762)	(1.181)	(1.235)	(.790)	(.828)	(1.130)	(1.138)	(1.554)	(1.688)	(1.211)	(1.260)

Notes: Weighted Logit regression coefficients and linearized standard errors. Each of the four price measures was estimated in separate regressions. † p<.10, \* p<.05, \*\* p<.01, \*\*\* p<.001

Table 5

Logit regressions of food insecurity: Implications of food price and consumer competency

	Food insecurity	Food insecurity	Food insecurity	Food insecurity
County average median basket	-.001 (.003)			
County average low-cost basket		.001 (.004)		
Block group average median basket			-.001 (.002)	
Block group average low-cost basket				.000 (.004)
In good financial condition	-1.844 (.286)***	-1.841 (.290)***	-1.850 (.284)***	-1.840 (.289)***
Review bills	.143 (.161)	.148 (.163)	.147 (.162)	.147 (.164)
Pay bills on time	-.686 (.201)*	-.673 (.205)**	-.686 (.203)**	-.672 (.204)**
Pay more than minimum	-.684 (.256)*	-.697 (.252)**	-.682 (.253)*	-.697 (.252)**
No defaulting	-1.001 (.201)***	-1.003 (.199)***	-.997 (.202)***	-1.003 (.201)***
No cash advance or payday loan	-.202 (.264)	-.195 (.262)	-.198 (.262)	-.196 (.262)
Shop with grocery list	-.064 (.192)	.068 (.190)	.063 (.190)	.067 (.190)
Use coupons	.055 (.195)	.074 (.191)	.059 (.191)	.072 (.191)
Use loyalty or other store savings	-.115 (.186)	-.142 (.181)	-.120 (.178)	-.139 (.179)
Guideline knowledge	-.309 (.188)	-.311 (.187)	-.309 (.189)	-.310 (.188)
Follow guideline	-.029 (.207)	-.036 (.210)	-.029 (.208)	-.35 (.210)
Use nutrition facts labels	-.120 (.219)	-.116 (.220)	-.115 (.219)	-.116 (.220)
Household characteristics	Yes	Yes	Yes	Yes
Food environment	Yes	Yes	Yes	Yes
Weekly fixed effect	Yes	Yes	Yes	Yes

Notes: Weighted Logit regression coefficients and linearized standard errors. \* p&lt;.05, \*\* p&lt;.01, \*\*\* p&lt;.001



Table 6A

Linear regressions of nutritional quality of acquired food: Implications of food price and consumer competency

	Fruit density	Whole fruit density	Whole grain density	Vegetable density
County average median basket	.001 (.001)	.000 (.001)	-.002 (.001)†	-.001 (.001)
In good financial condition	-.038 (.066)	-.056 (.066)	.146 (.075)†	-.213 (.140)
Review bills	-.048 (.065)	-.050 (.068)	.020 (.054)	-.028 (.097)
Pay bills on time	-.006 (.060)	-.006 (.058)	-.095 (.066)	-.026 (.137)
Pay more than minimum	-.000 (.046)	-.011 (.044)	-.089 (.093)	.080 (.123)
No defaulting	-.017 (.072)	.016 (.068)	-.063 (.072)	.104 (.115)
No cash advance or payday loan	.027 (.074)	.026 (.067)	-.134 (.0864)	.223 (.109)*
Shop with grocery list	.015 (.043)	-.007 (.044)	-.119 (.078)	.062 (.076)
Use coupons	-.068 (.059)	-.069 (.055)	-.090 (.084)	.117 (.133)
Use loyalty or other store savings	-.084 (.060)	-.091 (.059)	.169 (.076)*	-.291 (.143)*
Guideline knowledge	.074 (.050)	.065 (.052)	-.014 (.066)	.127 (.088)
Follow guideline	.077 (.091)	.070 (.090)	.006 (.078)	.003 (.093)
Use nutrition facts labels	.052 (.057)	.052 (.059)	.183 (.085)*	-.011 (.138)
Household characteristics	Yes	Yes	Yes	Yes
Food environment	Yes	Yes	Yes	Yes
Weekly fixed effect	Yes	Yes	Yes	Yes

Notes: Weighted Logit regression coefficients and linearized standard errors. † p<.10, \* p<.05, \*\* p<.01

Table 6B

Linear regressions of nutritional quality of acquired food: Implications of food price and consumer competency

	Energy density	Sodium density	SoFAAS percent
County average median basket	-.000 (.001)	-5.0 (2.1)*	.019 (.019)
In good financial condition	.228 (.069)**	-567.8 (418.9)	-3.654 (1.610)*
Review bills	-.036 (.061)	-232.6 (378.9)	2.079 (1.514)
Pay bills on time	-.081 (.058)	329.7 (210.2)	.542 (1.648)
Pay more than minimum	-.044 (.064)	-485.8 (221.7)*	-3.823 (1.808)*
No defaulting	-.089 (.075)	589.4 (397.4)	1.618 (1.989)
No cash advance or payday loan	.141 (.094)	-392.9 (455.4)	-.767 (2.247)
Shop with grocery list	.040 (.061)	-455.8 (303.5)	1.706 (1.710)
Use coupons	-.011 (.070)	-489.0 (355.3)	2.581 (1.456)†
Use loyalty or other store savings	.051 (.045)	271.2 (376.0)	.245 (1.482)
Guideline knowledge	-.002 (.047)	-240.7 (379.7)	-1.234 (1.692)
Follow guideline	-.044 (.061)	738.1 (674.7)	.576 (1.751)
Use nutrition facts labels	-.059 (.055)	-664.5 (366.2)†	-2.570 (1.509)†
Household characteristics	Yes	Yes	Yes
Food environment	Yes	Yes	Yes
Weekly fixed effect	Yes	Yes	Yes

Notes: Weighted Logit regression coefficients and linearized standard errors. †  $p < .10$ , \*  $p < .05$