THE IMPACT OF NUTRITION EDUCATION ON FOOD SECURITY STATUS AND FOOD-RELATED BEHAVIORS

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THE IMPACT OF NUTRITION EDUCATION ON FOOD SECURITY STATUS AND
FOOD-RELATED BEHAVIORS

A Thesis Presented

by

JAMIE A. FARRELL

Submitted to the Graduate School of the
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Department of Nutrition
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ABSTRACT

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Food insecure individuals do not always have access to adequate food for a healthy lifestyle and are at high risk of detrimental health outcomes. Researchers hypothesize that food insecurity leads to changes in dietary practices, including greater overall food purchase in times of adequate resources and purchase of low-cost, unhealthful foods when resources are constrained. Most measures of food insecurity do not measure changes in dietary practices and dietary quality. Research findings suggest education that provides alternative strategies to manage resources and improve dietary practices can improve food insecurity.

We assessed the relationship between 1) food security and ability to afford foods and 2) the impact of Expanded Food and Nutrition Education Program (EFNEP) in a low-income, multicultural population in Massachusetts. We used a pre/post-education survey design, including the USDA six-item Food Security Module (FSM), food-affordability questions and EFNEP behavior checklist.

EFNEP participants experienced high rates of food insecurity with over 40% of participants classified as food insecure (N=80). Pre-EFNEP, individuals in households with low food security were less likely to report being able to afford healthy foods (51.5%) and fruits and vegetables (57.6%) throughout the month compared to those in households with high (80.9%) and marginal (78.7%) food security (P=0.007, P=0.051). Individuals in households with marginal, low and very low food security were less likely to report being able to afford the same kinds of
food throughout the month compared to individuals in high food secure households (56.4% vs. 84%) (P=0.022). Individuals in food insecure households reported running out of food before the end of the month more often than their food secure peers (P=0.013). Post-EFNEP, a greater proportion of participants fell into the high and marginal categories of food security (60.0% to 71.7%, P=0.065).

Our results indicate that food insecure households have a harder time affording healthy foods throughout the month, leading to poor diet quality that possibly contributes to poor health outcomes. The food affordability questions may capture changes in dietary practices in food insecure populations throughout the month. EFNEP can provide skills and knowledge to at risk populations to improve abilities and combat food insecurity.
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CHAPTER I

INTRODUCTION TO FOOD INSECURITY

Introduction

In 2011, 50.1 million people in 17.9 million households in the United States struggled to provide adequate food for those they live with during some part of the year (1). These food insecure individuals may not be able to afford foods compared to those classified as ‘food secure’. The United States Department of Agriculture defines ‘food security’ as “access by all people at all times to enough food for an active, healthy life”. Conversely, food insecure households may either experience low food security with undesirable changes to the diet with no reduction of dietary intake or very low food security with reduced dietary intake and detrimental changes in dietary practices or eating patterns (1). Low-income individuals and households, particularly women, are at higher risk of experiencing food insecurity and thus of outcomes associated with decreased access to adequate food and resources (1, 2, 3, 4, 5). Another measure describes food insufficiency, where individuals in households have inadequate food intake secondary to lack of resources and report feelings of not having enough food during a specified time period (6, 7).

Food insecurity appears to have a negative impact on various aspects of health and wellbeing. Individuals living in food insecure households are more likely than those in food secure households to rate their own health has poor or fair and have lower physical and mental health (8). Food insecure individuals, especially women, are more likely that their food secure counterparts to be obese (9, 10, 11, 12), gain weight (10), and have cardiovascular disease and diabetes (11, 13, 14). Food insecure populations are also more likely to exhibit disordered eating patterns (15), have decreased household availability of healthful food groups and foods compared to food secure (16, 17). Additionally, food insecure populations are more likely to have increased intake of less healthful nutrients (18). Food insecure children are more likely to have poor health compared to food secure children (19) and children experiencing hunger, are more likely to show symptoms of decreased psychosocial functioning (20). Food insecurity and/or lack of resources experienced early in life increases the chances of obesity, disordered
and unhealthy eating patterns (21, 22) and food insecurity in adulthood (16). Similarly to food insecurity, food insufficiency has been associated with poor health (8, 6), chronic disease, poor functional health, depression (6), altered nutrition-related laboratory values and decreased intake of healthful food groups (23).

Given that food insecure populations may lack ability to afford food, food insecure households may change dietary practices or use certain food-related behaviors to delay hunger and manage resources. Strategies such as using coupons and leftovers, freezing meals, and participating in food assistance programs may be beneficial, but other strategies may be detrimental to health. Changing frequency of shopping, borrowing money, putting off payment bills, choosing food over other expenses, limiting certain ‘costly’ ingredients, pawning, eating expired foods or engaging in illegal shopping practices are only some of the many practices that food insecure individuals and families use to provide food when resources are constrained (24, 25, 26, 3, 21).

How and why food insecurity contributes to increased health risk and altered behaviors is complicated and multifactorial. Theories, such as the energy density hypothesis, claim that individuals with limited resources will be more likely to purchase more energy dense, less nutritious foods that promote weight gain (20, 27). Additionally, food insecure individuals who receive food stamp benefits may purchase foods in a cyclical pattern, purchasing the majority of foods immediately after receiving benefits. This can lead to general overconsumption and purchase of foods after receiving monetary resources and increased purchase of low-cost/energy-dense foods when resources are limited. This practice may contribute to increased intake at that point in time and depleted resources later in the month (28). Ultimately, certain changes in dietary practices and behaviors utilized in an effort to alleviate the strain food may exacerbate negative health consequences.

Interventions that alleviate or prevent both food insecurity and its dietary consequences may improve long-term health outlooks in vulnerable, low-income populations. The Institute of Medicine released a report evaluating the adequacy of SNAP benefits. The committee of experts recommended further research in assessing resource management understanding of SNAP participants, and highlighted
the importance and need for education in this area (29). Food insecure individuals engage in certain strategies to acquire food or manage their resources (25, 26, 30, 31). Programs that provide skills and knowledge targeted at these identified behaviors can help food insecure individuals manage their food purchases. Since 1968, the Expanded Food and Nutrition Education Program (EFNEP), part of the USDA FNS, has provided nutrition education to low-income families to assist in acquiring the knowledge, skills and motivation that are essential for successful behavior change (32). Participation in EFNEP has been directly associated with improved food security status (33, 34). Individuals who participate in EFNEP experience positive changes in certain categories of food related behaviors such as nutrition practices, food-resource management behaviors (35, 36, 37), improved dietary intake and household availability of healthful foods and nutrients (38, 39, 40), as well as improved general health (33). These dietary and resource management behaviors are associated with more healthful dietary intake may indirectly improve food security status (41, 42, 43, 38, 44). Adoption of these behaviors and indirect improvement of food security status may ultimately lead to improved overall health and decreased risk of chronic diseases. With improved food security status, these at-risk populations can continue to engage in lifestyles that promote beneficial health outcomes and diminish the risk of negative health outcomes associated with food insecurity.

Introduction to study and research questions

The research documenting EFNEP’s effect on food security status has used the common 10-item checklist tool of the Cooperative State Research, Extension, and Education Service of the USDA food insufficiency question, “How often do you run out of food before the end of the month?” Responses include, “Do not run out of food”, “seldom”, “sometimes”, “most of the time” or “almost always”. The question does not directly measure food security status, but indicates the extent of household food sufficiency (45). A limited number of studies have evaluated EFNEP’s impact through the USDA U.S. Household Food Security Module (USDA FSM). However, the USDA FSM questions do not focus on food-related behaviors associated with food insecurity that have potential nutritional and health outcomes. There is limited research that utilizes questions that measure changes in dietary practices related to food
security, or how EFNEP education may influence these changes. Cyclical changes in dietary practices, such as increased overall purchases in times of adequate resources and increased purchases of low-cost/energy-dense foods, may be associated with poor health outcomes.

This thesis research aimed to provide further support for EFNEP’s ability to improve food security status by teaching positive food-related behavior change associated with food security. The research:

- Assessed the association between food security status and newly developed food-affordability questions
- Assessed the effect of EFNEP on food security status
- Assessed the effect of EFNEP on behaviors related to adverse health outcomes associated with food security: standard EFNEP food-related behavior questions, and additional food affordability survey questions targeted to measure changes in dietary practice associated with food insecurity
CHAPTER II

LITERATURE REVIEW

Nutrition education may help improve household food security status and unhealthful food-related behaviors associated with household food insecurity. Food security measurement tools assess the prevalence of food insecurity and identify at-risk populations. Researchers who investigate populations experiencing food insecurity can identify possible direct dietary consequences of food insecurity and further consequences of dietary practices or behaviors seen in food insecure populations. Potential solutions, such as nutrition education, may alleviate food insecurity and its dietary and health consequences despite the complicated interrelationship between food security, food-related behaviors and health outcomes. Standard measurements of food security do not include questions of food-related behaviors that may be associated with food security status. Questions that address change in these behaviors could serve as an additional method for measuring and describing change in food security status. The conceptual model (Figure 1) and literature review detail the relationship between food security, nutrition education, health outcomes and mediators.

Measurements of Food Security

Multiple survey tools measure food insecurity or lack of food resources in the household. Broadly, two categories of measurements exist: those that measure through a single question and those that utilize a scale to measure the extent of food insecurity.

The USDA Food Sufficiency Question is a single question indicator: “Which of the following statements best describes the food eaten in your household?” Responses include, “Enough of the kinds of food we want to eat”, “Enough but not always the kinds of foods we want to eat”, “Sometimes not enough to eat” or “Often not enough to eat”. Individuals that respond having ’sometimes’ or ‘often’ not enough to eat in the household are often classified as food insufficient (45). Although current use of this measurement is limited, investigators used the
Researchers and government agencies also use scales to determine the level of and changes in food security status. The 13-item Radimer/Cornell measure of hunger and food insecurity indicates severity in three subscales: household, women and children (46). More frequent responses of “often” or “sometimes” true indicate increasing food insecurity and hunger status. Based on the previous work of individuals including Radimer (47) the most commonly utilized tool is the USDA U.S. Household Food Survey Module (USDA FSM). The FSM consists of an 18-item scale that divides the severity of food security into four categories: high food security, marginal food security, low food security and very low food security. The scale measures the severity of food insecurity using questions that address the household’s status over the past 12 months or past 30 days. Additionally, six-item and ten-item short form versions of the USDA FSM are substitutes for the 18-item USDA FSM when survey space is limited (48).

Prevalence and Populations at Risk of Food Insecurity

National prevalence statistics from population-based surveys illustrate that food insecurity exists in the United States (1, 2, 49). Households do not always experience the same duration of food insecurity. Nord et al. (2002) analyzed the extent to which food insecurity is occasional, recurring or chronic, using data from the Current Population Survey Food Security Supplement (CPS-FSS) data in combination with the food security scale in 1998. They reported that 2/3 of food insecure households experienced recurring food insecurity (report of ‘occurring often’ or in 3 or more months in the past year) and 1/5 of those that reported ‘recurring’ food insecurity experienced food insecurity as a ‘chronic’ situation (occurring often or in almost every month). Thirteen percent of households felt that they sometimes ‘worried food would run out’ and 3.6% reported this was often true (49).

Analysis of cross-sectional, population-based surveys has identified vulnerable sub-populations. While 14.9% of all households in the U.S. experienced food insecurity at some time
in 2011, the rate was 36.8% for those households with children headed by a single women, 24.9% for households with children headed by a single man and 25.1% for Black, non-Hispanic and 26.2% for Hispanic households (1). Compared to higher income households, low-income households are more likely to experience food insecurity (1). Approximately 41.1% of individuals with income below the Federal poverty line ($22,811 for a family of four in 2011), were food insecure in 2011 (1). Low-income, households with single mothers, lower levels of education and race or ethnicity other than non-Hispanic white or Asian are important predictors of food insecurity in an analysis of 70,942 households with children using data from the 1998-2001 CPS-FSS (2).

The National Health and Nutrition Examination Survey (NHANES) measures food security using the USDA FSM and has been useful in cross-sectional analysis of variables associated with food security status, including populations at risk. Analysis of data from NHANES 1999-2004 revealed Latino households were more likely to be food insecure than white households (P<0.001) and low educational attainment, low household income, lack of health insurance, and tobacco use are significantly associated with food insecurity across the study population (all P<0.001) (11).

Women, especially low-income women and single mothers, are more likely to experience food insecurity than men (5, 50, 51). Kendall et al. (1995) reported a significant increase in the percentage of subjects that were low-income and less educated as food insecurity worsened in a sample of women and children living in rural New York State (N=193) (5). This sample of mainly white women completed interviews that included inventory of household food supplies. In a later investigation of the same study, researchers found that women in single parent households were significantly more likely to be food insecure than those of other household status (odds ratio (OR) =3.71, 95% confidence interval (CI) =1.36, 10.14). Overall, variables that significantly contributed to food insecurity were being a single parent, lack of savings, larger household size, unexpected expenses and adding $50.00 or more to food stamps in order to purchase sufficient
food (all P<0.05) (3). Similarly, cross-sectional analysis of data from the Panel Study of Income Dynamics has pinpointed that single women seem to be at higher risk for food insecurity, and more specifically women that are younger, single, less educated, Black or Hispanic (4).

Individuals that receive supplemental assistance are also at high risk of food insecurity. Assistance programs provide direct financial benefits to individuals and families to purchase food. In the U.S., the federal Supplemental Nutrition Assistance Program (SNAP, or Food Stamp Program (FSP) prior to 2008) aims to attenuate the hunger, food insecurity and ultimately the related health consequences experienced by low-income populations by providing benefits and education (52). The USDA FNS administers this program federally, and oversees state agencies that distribute the actual benefits. In the federal fiscal year 2011, 44,708,726 individuals and 21,072,113 households received food stamp benefits (53). Analysis of nationally representative data has revealed that individuals that received food stamps were actually more likely to be food insufficient than those that did not participate in the food stamp program (54). Many researchers have found either no association or a positive association between receiving food stamp benefits and food insecurity (55). Those who self-select into a food stamp program do so when they are most food insecure; therefore, populations at risk of food insecurity are also likely to receive assistance. This occurrence makes it difficult to determine cause and effect and clouds the relationship between assistance and food insecurity, particularly using cross-sectional data (56). Although supplemental assistance programs are peripheral to the conceptual model tested in this research, this relationship is of importance because programs such as EFNEP are most likely to enroll those who receive federal supplemental assistance.

**Health Consequences of Food Insecurity**

Food insecurity is positively associated with poor health status and chronic diseases in various cross-sectional research studies that utilize large population based data, health surveys and the USDA FSM. Greater proportions of food insecure compared to food secure households
rate their health as poor/fair, and score significantly lower on physical and mental health scales (8).

Considering the potential relationship between general health status and food insecurity, researchers have examined the prevalence of chronic disease in more specific at-risk populations, such as women. Cross-sectional data analysis of large population based health studies has revealed a positive association between food insecurity and obesity in women (11). In one study, non-Hispanic white women who were food insecure without hunger had greater odds of being obese than those who were food secure (OR 1.36) (9). Townsend et al. (2001) found that mildly food insecure women were 30% more likely to be overweight than those who were food secure (OR 1.3, P=0.005) in an analysis of data from the CSFII 1994-1996. There was no difference in weight status between food insecure and food secure men. Although these cross-sectional studies provide support for the positive association between food insecurity and obesity, they cannot establish causality (12).

Cross-sectional research design associates food insecurity and obesity at one single point in time, compared to a temporal design such as a prospective cohort or intervention study where one can measure the effect of food insecurity on weight gain over time. Food insecure women are at higher risk of obesity and overweight at one point in time, but food insecurity may also contribute to weight gain. Wilde and Peterman (2006) addressed this limitation by examining the impact of food security status on self-reported and measured weight change over 12 months (10). They utilized NHANES (1999-2002) data and found that women identified as marginally food secure and food insecure without hunger were significantly more likely to be obese (OR 1.76, P<0.05) compared to women that were fully food secure. Additionally, marginally food secure women were significantly more likely to have gained 4.54 kg (10 pounds) or more over 12 months compared to fully food secure women (OR 1.68, P<0.05) (10). Because this study considered the relationship between food security change in weight over time, rather than the less
descriptive cross-sectional relationship between food security and weight, these results support
the hypothesis that food insecurity may lead to weight gain.

Food insecure populations have a higher prevalence of chronic diseases associated with
obesity and overweight in analysis of cross-sectional large population based data. Chronic
diseases positively associated with food insecurity include hypertension, hyperlipidemia, and
diabetes mellitus (14, 11). Other researchers found that women classified as marginally food
secure are more likely to have abnormal levels of clinical cardiovascular disease biomarkers
compared to fully food secure women, the association was not seen in food insecure men (13).

Measurements of food insecurity occur at the household level, implying that food
insecurity affects individual members of the household, including children. Cross-sectional data
analysis from a cohort study revealed that food insecure children have increased odds of having
fair or poor health (AOR 1.90) and increased odds of hospitalization since birth (AOR 1.31)
compared to food-secure children (P<0.05). Additionally, as severity of food insecurity worsened,
the odds of the report of children’s health to be fair or poor increased showing a dose response
relationship (19). The cross-sectional nature of the survey and non-random selection of
participants limits assumption of causality and generalization of these results. Despite these
limitations, this study provides interesting evidence of the impact of household food insecurity on
the youngest members of the household.

Considering the evidence that food insecure populations, especially low-income, women
and minorities, seem to be at higher risk of obesity and chronic diseases associated with weight,
these populations may benefit from interventions aimed at improving food security status.
Interventions that lead to dietary behavior change can improve the quality of food in the
household. Improved dietary quality can help to minimize chronic disease outcomes associated
with food insecurity.
Potential Mechanisms of Food Insecurity and Chronic Disease

Although the relationship between food insecurity and chronic disease is complex, researchers have identified connections between early life experiences and food insecurity outcomes in adulthood (21, 22). Other potential mechanisms include the consumption of generally less nutritious and healthful diets, the energy density hypothesis and cyclic food purchase and consumption patterns. Understanding these mechanisms is important in the design of education interventions that aim to improve food security through changing behavior and increasing knowledge and skills.

Qualitative and quantitative analyses have described the effect of low-income or lack of resources in childhood on outcomes during adulthood. Researchers have found that experiencing food insecurity during childhood may increase the likelihood of obesity and alter behaviors in adulthood. The report of growing up poor, defined by women’s parents’ education (less than high school) and being a recipient of welfare when growing up, was significantly associated with increased probability of obesity and overweight in their adulthood (N=19, P<0.01) (21).

Researchers found a positive relationship between overweight, obesity and food insecurity and disrupted/disordered eating patterns (21). Results shed light on future consequences of food insecurity experienced during the early stages of life, providing support for the need of intervention early in life to prevent or later in life to diminish negative undesirable outcomes.

Dietary Intake

Individuals in at-risk populations that experience food insecurity are more likely to consume nutritionally inadequate diets in times of limited resources compared to their more food secure counterparts (15, 16, 18, 57, 58). Dietary alterations secondary to food insecurity may further explain the relationship between food insecurity and chronic disease. Inadequate intake of certain food groups, such as fruit and vegetables, has been associated with increased likelihood of chronic diseases such as cardiovascular disease, diabetes and cancer (59, 60).
Cross-sectional studies provide evidence that supports the hypothesis that food insecure individuals are more likely to consume less of certain healthful foods compared to food secure peers leading to nutritional inadequacy. Leung et al. (2012) found that the majority of 3,835 low-income adults did not meet food and nutrient guidelines and that SNAP participants had a lower dietary quality score than non-SNAP participants (57). Researchers found a negative association between frequency of consumption (times per week) of foods (fruits, vegetables and juice) and food insecurity in women. Additionally, the number of times per week the participants consumed servings of fruit juice, fruit, salad, potatoes, carrots and vegetables combined were lower as food insecurity worsened (P<0.001).

Food insecurity may negatively affect the availability of food resources in a household, highlighting the importance of household members’ abilities to manage financial and food resources throughout the month or during times of food insecurity. Researchers have found that household food supplies including dairy, meat, grains, fruits and vegetables became significantly lower as food insecurity status worsened (P<0.001) (15). Food insecurity experienced over time may negatively affect the availability of food resources in a household in that time period. Researchers found through cross-sectional surveys of food insecure households in six California counties, that food insecurity over the past three months was associated with lower household food inventory of certain food groups, including dairy, grains, meats and vegetables. Low-income Latino families (N=256) with preschool children from Women Infants and Children (WIC), Head Start and other community based organizations participated in the survey. Data collected during interviews at home or in community settings included the 18-item USDA FSM and self-reported food inventory. Food insecurity over the past three months was associated with lower household food supplies of dairy (P<0.01), fruit (P<0.001), grains (P<0.0001), meats (P<0.001), snack foods (P<0.001) and vegetables (P<0.001) when maternal education was controlled for in the model (16). Mello et al. (2010) found in an analysis of telephone collected data from 1,874 (55% Hispanic, 85% women) low-income adults that fat intake was significantly higher in food
insecure individuals (P<0.05) and fat-lowering behaviors were less likely to be seen in food insecure compared to food secure individuals. To investigate this association, researchers used pooled data from the National Cancer Institute intervention aimed at increasing fruit and vegetable consumption and decreasing fat intake through written nutrition education delivered to low-income individuals. A question asking if the participant has been concerned about having enough food for the family in the past 30 days indicated food insecurity (18).

Finally, analysis of the biochemical impact of diets consumed by limited resource populations supports findings of survey data. Food insufficiency has been associated with altered nutrition-related laboratory values. In a cross-sectional study of data from the Third NHANES 1988-1994 that included young and older adults of various ethnicities, survey participants who were food insufficient had lower serum levels of nutrients and less frequent intake of certain food groups. Younger adults ages 20-59 (N=454) were more likely to have calcium and vitamin E intakes below 50% of the recommended amount for these nutrients compared to food sufficient younger adults (N=5,844). Food insufficient younger adults (N=468) had lower frequency of consumption of dairy, fruit and vegetables compared to food sufficient younger adults (N=6,007). The food insufficient respondents also had lower mean serum concentrations of total cholesterol, Vitamin A and carotenoids. Food insufficient older adults ages 60 years and older (N=131) had lower serum concentrations of HDL, albumin, vitamin A, vitamin E and carotenoids compared to food sufficient older adults (N=3,559) (23). Overall, the results from these studies provide supporting evidence that those from food insecure households have less healthful diets that could potentially increase risk of diet-related chronic diseases.

**Energy Density**

Food insecurity may lead to increased intake of energy dense foods, which may contribute to the poor health outcomes associated with food insecurity. Food insecure households may perceive nutritionally dense foods, such as fresh produce, whole grains and lean proteins, as more expensive, and substitute these for these less expensive alternatives such as refined grain
products, sweetened beverages and processed packaged foods. Less expensive alternative food items are often calorically dense and higher in added sugars and fats and lacking in nutrients (20, 27, 28). Increased consumption of these foods may lead to excessive calorie intake, contributing to weight gain. Individuals in food insecure households who consume less nutrient-dense foods, such as fruits and vegetables, and higher fat foods may be at greater risk for the development of chronic diseases that have been associated with diets low in fruits and vegetables such as cardiovascular, diabetes and cancer (59, 60).

Intervention research supports conceptual frameworks that link purchase and consumption of energy dense foods to weight gain and decreased intake of energy dense foods with weight loss (61, 62). If food insecure individuals view energy dense foods as less expensive and more affordable, the increased purchase and consumption of these foods may promote weight gain (27). Conversely, decreased consumption of these foods and increased consumption of nutrient-dense foods may promote weight loss or prevent excessive weight gain. Measurements of the association between the frequency and ability of food insecure populations to purchase nutritious, energy dense foods, could provide insight into this one potential mechanism between food insecurity and weight related health outcomes.

Cyclic Eating Patterns

The monthly distribution cycle of supplemental assistance may lead to cyclic eating and purchasing patterns. Wilde and Ranney (2000) reported that mean food spending (dollars per person per day) peaks within the first three days after receiving benefits. This analysis used the nationally representative Consumer Expenditure Diary Survey (CESX; 1988-1992) and CSFII (1989-1991) data sets to analyze food purchasing and frequency of shopping in households that receive food stamps. Survey respondents in households that shopped for groceries once a month had a significant decrease from 83% of the Recommended Dietary Allowance (RDA) for food energy in the first week to 73.4% in the fourth week of the month (P<0.05). Households that shopped more than once a month showed no significant decrease. The sum of all household
members energy intake divided by the sum of all members’ reference energy intake defined 
household food energy intake (63). The authors suggest that increased frequency of shopping, 
Opposed to less frequent shopping, seems to allow for better regulation of resources throughout 
the month: food budgeting to allow for increased shopping frequency could be a potential 
solution for eliminating cyclic patterns (28). In the Wilde and Ranney analysis, foods purchased 
in high quantities at the beginning of the month were easily preserved foods such as grains and 
canned vegetables, but also included perishable items such as seafood and dairy products. The 
researchers proposed that this may represent “splurging” upon receiving benefits. If the majority 
of food consumption occurs at this time of “splurging”, increased intake of energy after receiving 
benefits over many months could contribute to small increments in weight gain over time. 

Measurements of food security status should address the cyclic purchasing behaviors of 
individuals in food insecure households. After receiving benefits, individuals in food insecure 
households may purchase different foods compared to what they may purchase throughout the 
rest of the month. Individuals that receive assistance may run out of money and food resources by 
the end of the month. This can lead to decreased quality of diet and possibly increased 
consumption of inexpensive, unhealthy food items at the end of the month. Spending resources at 
the beginning of the month provides nutritious foods immediately for food insecure households. 
However, if these foods are not able to last throughout the remainder of the month the households 
will have to purchase foods that may be less desirable, less healthy and less costly at the end of 
the month.

Food Related Behaviors

In times of limited resources, individuals experiencing food insecurity are likely to 
engage in food-related behaviors or strategies to improve their ability to acquire food and 
adequate nutrition or to manage resources. Although food insecure individuals likely employ 
certain strategies to better manage and alleviate consequences of constrained resources, some 
strategies may further contribute to detrimental health outcomes in at risk populations.
Using surveys and qualitative methods, researchers have identified strategies that involve management of the food supply, household resources, finances and regulation of eating patterns used by populations at risk of food insecurity. In the previously described research by Olson et al (1996), food insecure individuals (N=103) made significantly more frequent use of resource management strategies such as borrowing money for food, using food pantries and commodity foods compared to food secure individuals (N=90, all P=0.001) (3).

Descriptive research has identified coping strategies and behaviors that populations with limited resources use. Researchers qualitatively described strategies used by food pantry users such as preparing food in bulk, using leftovers, coupons, food sales, delaying payment of bills, and deciding between food and other supplies (26). In another study, nutrition educators from EFNEP and the Food Stamp Nutrition Education Program (FSNEP) identified practices used by low-income, limited resource populations including creating low cost meals, limiting second portions, preserving foods, restricting personal intake, overeating when food becomes available, exhibiting a cyclical monthly eating pattern and eating unsafe food (30). It is evident that management skills of both financial and food resources may have a role in one’s ability to maintain food security and these behaviors could occur more frequently in times of limited resources or food insecurity.

**Potential Solutions: Nutrition Education**

Programs and interventions provide members of at-risk populations with tools, skills and knowledge to alleviate the complications of limited resources and improve food insecurity and insufficiency. Food assistance, education and the EFNEP are three venues that can attenuate detrimental outcomes.

Modification of dietary intake and behaviors may potentially reduce the risk of chronic disease in food insecure populations. Successful education may manifest itself through better resource management skills, physical weight loss or improved clinical indicators of disease when directed to food insecure populations. Although the association is not directly clear, researchers
provide evidence that nutrition education given to populations with chronic disease can be effective in increasing nutrition knowledge associated with behavior change and improvements of chronic disease states such as obesity and diabetes in intervention studies (64, 65, 66).

In addition to reducing the risk for chronic diseases, nutrition education may improve food security status. Supporting evidence includes measurement of direct association, such as a change in USDA FSM categorization post education. Other evidence of the association suggests that improvement of food security is occurring through mediators, including attainment of resource management skills, leading to overall improved food security. A single-blind randomized intervention trial tested the effectiveness of the FSNEP. Eicher-Miller et al. (2009) found that education given to a low-income population in Indiana improved food security status. The experimental group completed five FSNE lessons (N=137) while the control group did not receive education (N=82). Participants completed a pre- and post-test that measured outcomes of food insecurity and food insufficiency through the six-item USDA FSM and USDA Food Insufficiency Question. Those that received FSNE had statistically significant improvements in both food insecurity (P = 0.03) and food insufficiency (P=0.04), meaning that they were more secure following the education intervention compared with before the intervention. The results of this intervention study provide evidence that education (that includes food preparation tips, healthful food selection and budgeting) given to a population of low-income; potentially food insecure individuals can be effective in improving food security status (31).

Education that teaches resource management skills can improve food security. Gunderson et al. (2012) found that low income households that reported being confident in their financial management skills had a 26.2% probability of being food insecure and households that were not confident in their skills had a 66.4% probability of being food insecure (N=280) (67). Utilizing the Survey of Household Finances and Childhood Obesity, the researchers reported a significant inverse relationship between participants reported use of financial management practices and food insecurity (67). Researchers also suggest that women with children who use a greater
number of food and financial management skills and behaviors such as stretching groceries, preparing meals, managing bills and budgeting are more likely to have food-secure households compared with those who use fewer of these skills (68). Olson et al. (2004) recruited mainly non-Hispanic white families with children in low-income households from 14 states. Participants were interviewed and completed the 18-item USDA FSM and a management skill assessment (N=316). Although families with low levels of food and financial management skills were more likely to be food insecure, having a greater number of these skills as well as a greater knowledge of community resources were significantly protective against food insecurity (P<0.05) (68).

Evidence links certain resource management skills, dietary practices and behaviors to food security status. Practices such as cyclic purchasing and eating patterns, may play a role in the development or prevention of poor health outcomes. Programs such as EFNEP and FSNEP that address food insecurity in at risk populations should consider this evidence: education that targets behavior change in identified behaviors and practices could indirectly improve food security and health outcomes. A retrospective study compared the effect of education given to food stamp recipient program participants to non-recipient participants and found that education leads to significant changes of food-related behaviors in both groups. The low-income adults (N=4,121) were pooled from Virginia and South Carolina EFNEP and FSNEP and utilized baseline and post intervention data from the Evaluation/Reporting System (ERS) and food behavior checklist. All participants made significant improvements in the 10 food-related behaviors measured through the checklist (P<0.005), supporting the hypothesis that these specific resource management and food behaviors can be successfully improved through education (69).

In a 2013 report evaluating the adequacy of SNAP benefits, the committee of experts indicated factors such as food preparation time, location price variations and access to nutritious food as potential considerations when determining the adequacy of SNAP benefits (29). Financial and resource management education could help low-income households better manage their resources and lessen the complications caused by these factors. Overall, education may improve
food security status, resource management behaviors, dietary intake and ultimately the health status of at risk populations.

**The Expanded Food and Nutrition Education Program (EFNEP)**

Findings from research support EFNEP’s cost-effectiveness, ability to improve food security status, and ability to promote behavior changes that can further improve food security status, dietary intake and poor health outcomes. Participation in EFNEP is associated with improved food security status measured through survey assessment of food security. Additionally, resource management behaviors, nutrition practices and dietary intake improve with participation in EFNEP. The EFNEP Behavior Checklist measures change that occurs through EFNEP participation that is supplementary to a 24-hour dietary recall. Participants answer the checklist at the initiation and completion of an EFNEP program. This checklist includes questions that measure change in the participant’s and/or household’s diet quality, management of food resources, food handling practices and food preparation skills as well as mastery of living situations and self-esteem. Through evaluation and feedback from focus groups, expert panel discussions, input from various state’s EFNEP programs and pilot studies the current 10 item checklist was developed. In the development and testing of the current checklist, participants exhibited positive behavior change in all 10 items in seven states during pilot testing (36). Results support the reliability of the checklist, and show that EFNEP may play a role in improving these categories of behaviors in certain populations.

**Cost Benefits**

Well-designed and delivered nutrition education has potential benefits to individuals and society. The benefits of EFNEP outweigh the costs associated with program implementation in multiple studies that examine savings by various methods. Researchers calculated a cost-benefit ratio (1:3.63) of Oregon’s EFNEP program with costs defined as expense to implement the program and benefits as the potential health related savings from the prevention of chronic disease conditions (70). The food and nutrition changes that occur through EFNEP education can
also reduce health care costs and improve the quality of life beyond the cost of the program. Based on a calculation performed by a New York State EFNEP program, at a program cost of $892.00 per graduate, education saved $20,863.00 per quality adjusted life years (the estimated years of life expectancy gained as result of health improvements) (71). Furthermore, improved dietary habits taught through EFNEP may lead to more healthful nutrient intake that may aid in the prevention of chronic disease. Authors calculated an estimated cost-benefit ratio that quantified potential dollars saved on health care costs by preventing chronic disease compared to the program cost of EFNEP in a retrospective study. For every dollar spent on the EFNEP program, the potential exists to save over 10 dollars in future health care costs (72). Results of these studies show that EFNEP is cost effective in dollar measurement for the program implementers and participants.

Improved Food Security

Researchers have examined how EFNEP participation may be positively associated with direct measurement of food security. In an intervention study of EFNEP participants, equally distributed by race, those who had exposure to the greatest number of EFNEP lessons were more food secure and were in better health. In this study, Greer and Poling (2001) observed the difference between 245 participants in a non-intervention group that had completed less than one lesson in EFNEP versus 332 participants of an intervention group that had completed two or more lessons. Data was collected in 18 counties in Tennessee from currently enrolled EFNEP participants or eligible participants. Participants answered one question asking them to rate their health status. Following the intervention those that participated in a greater number of EFNEP lessons were almost two times more likely to be food secure and were more likely to report having ‘good’ or ‘better’ health than those who did not participate (33). Those in the non-intervention group were almost two times more likely to be food insecure. This study provides basic support for the effect of education given through EFNEP to improve the food security status of low-income participants through a validated measure.
Similarly, Dollahite et al. (2003) further described the impact of nutrition education administered through New York State EFNEP to decrease food insecurity status of a multiethnic, low-income population. Pre-existing data for the pre- post-test comparison group design compared 15,846 individuals who had completed six or more lessons in EFNEP to 300 individuals who had terminated prior to graduation. The researchers compared the answer to the EFNEP food sufficiency question (outcome variable) to graduation status from EFNEP defined as the completion of six or more lessons and completion of surveys. Comparison of pre- and post-test scores showed a significant decrease in food insecurity (P<0.05) with a noted difference between those that graduated and terminated (P<0.055). Additionally, the number of lessons completed by participants was significantly associated with the degree of change in food insecurity score. With each additional lesson, a 0.015 point decrease in food insecurity score was seen (P<0.0001) (34). When all other variables included in the model were controlled for, the graduated participants had significantly greater decrease in food insecurity score significantly compared to those that terminated early (P<0.001). Results provide support that education through EFNEP may have a dose response relationship with improvement in food security status.

**Improved Food-Related Behaviors**

EFNEP education may lead to improved resource management, food preparation and shopping practices, which can enhance household availability of resources, dietary quality and ultimately health. EFNEP programs teach food-resource management behaviors, such as shopping practices. An analysis of self-reported checklist data from the National Food Stamp Program (NFSP) and EFNEP surveys found that food-shopping practices were significantly associated with availability of household nutrients and increased individual consumption of nutrients. NFSP 1996 survey included 957 respondents who completed a seven-day food use record to calculate RDA intake, and a food shopping practice checklist. Researchers found that there was a significant relationship between specific shopping practices such as using coupons, shopping lists and comparison shopping, and having 100% of the RDA in the household for
certain nutrients (P<0.01). EFNEP surveys included the 10-item checklist and 24-hour dietary recall data from 5,159 women from various states. Analysis of EFNEP survey data revealed that women who reported planning meals ahead of time were significantly more likely than other women to meet the RDA for Vitamin A (P<0.01) and those that almost always read the nutrition label had a significantly lower consumption of fat than those who used the nutritional facts label less (P<0.01)(41). The assumption of cause and effect is limited in this cross-sectional data; however, this study provides evidence of a relationship between food shopping practices and nutrient intake in low-income households. Educating individuals about food-resource management behaviors may play an important role in improving nutrient availability in the household and therefore overall health.

Another study evaluated EFNEP participants (N=750) in Michigan (95.2% female, 25.2% Hispanic) and found that participants experienced significant improvements in behaviors measured through pre and post education analysis of the EFNEP 10-item checklist. Significant improvement was seen in increased used of grocery lists, planning meals, budgeting money for food, using food labels and thinking about healthy food choices (P<0.001). The population also reported worrying about running out of food less often and running out of food less often (P<0.001), a measurement that is associated with improved food security status (43). Studies that evaluate pre and posttest answers from the food behavior checklist and 24-dietary recall data collected from Iowa’s EFNEP and FSNE provide evidence of similar improvements. Significant positive change of food behaviors such as planning meals, comparing prices, using grocery lists and reading labels more often (P<0.05) was indicated after program graduation (38).

EFNEP education that is associated with improved resource management behaviors saves participants money, increasing available resources and improving food insecurity. Burney et al. (2002) calculated the grocery savings of Tennessee EFNEP participants who received nutrition education and collected food receipts compared to those who did not receive education and collected food receipts. The graduated groups averaged a $10-$20 per month ($124-$234 per
year) decrease in family food expenditures. The intervention group that collected receipts saved approximately $10.00 a month and the uneducated control group spent an average of $5.52 more on food per month. These results may indicate that participants in the EFNEP education group gained resource management skills, such as comparing prices, in order to save on food costs each month. Average scores that measured practices such as meal planning, comparing prices, making shopping lists and running out of food less at the end of the month were all significantly improved for the participant group compared to the control group (P<0.01) (37). Research has shown that low-income populations that participate in EFNEP can improve behaviors related to food security, which may indirectly improve food security status and decrease poor health outcomes.

**Improved Dietary Intake**

EFNEP participation can enhance the diet quality of at risk populations by encouraging dietary behavior changes. In an evaluation of EFNEP and FSNE curriculum (2005, 2006, 2007) voluntary recipients, consisting mainly of white females, experienced improvement in their dietary intake after education (38). Pre- and post-test answers from the food behavior checklist and 24-dietary recall data were compared. Significantly improved intake results included increased number of servings of meat, dairy, vegetables, bread and fruit (P<0.05). Increased food from these groups resulted in increased intake of nutrients such as fiber, calcium, Vitamin A and Vitamin C (38).

Randomized control trials have also provided support that education provided through EFNEP can lead to beneficial changes in consumption of food items and nutrients in the household. The study involved a comparison between an intervention group of 582 Texas EFNEP participants who received a new EFNEP curriculum and a control group of 424 who received the usual EFNEP curriculum (combined participants 97% women, 89% Hispanic). Data were collected at baseline, post intervention and four months after completion and included a 24-hour dietary recall and behavior checklist questionnaire. Overall energy intake and sweetened beverage
consumption was significantly lower post intervention and at follow up. Participants increased fiber, 2% milk and vegetable intake post intervention. Menu planning skills significantly increased at post and follow-up in control and intervention groups. The results of this study helped to validate use of the new curriculum for this Texas EFNEP and provided evidence for the behavior change that is associated with an overall higher quality diet (39). Fruits, vegetables, high fiber foods and lower fat dairy are lower in calories compared to more energy dense foods: increased consumption of these foods is associated with decreased energy intake. As referenced earlier, evidence supports diets consisting of nutrient dense foods rather than energy dense foods to fight obesity and chronic diseases.

Increasing intake in certain food groups through participation in EFNEP is one aspect to improving overall dietary quality, but EFNEP participation may also be important in targeting change of food preparation practices that effect dietary quality. Low-income mothers (N=97) that were recruited by a California EFNEP program provided information about food preparation and consumption of intake during a typical week. Families that were preparing more dishes from scratch, purchasing fruits and vegetables and using a variety of cooking methods were able to meet a greater number of RDAs of certain nutrients. The families engaging in a greater number of these practices were meeting less than two-thirds the RDA for less than two nutrients compared to participants defined as less adequately nourished families that were meeting less than two-thirds the RDA for three to fifteen nutrients (42). To further support these results, a randomized control trial investigating the effectiveness of a revised curriculum for Texas EFNEP found that intervention of education was associated with significant increases in participants menu planning skills measured through a scale of positive practices. Researchers randomized 1,104 EFNEP participants into two groups that received the new curriculum or standard curriculum. Post intervention, there was a significant increase in fiber, 2% milk, vegetables, fruit and juice intake (39).
Self-reported survey data may be questionable in validity and reliability of measured behavior change secondary to recall bias, especially in regards to the 24-hour diet recall. Laboratory evidence of serum dietary intake markers supports results of self-reported survey data. Female food stamp recipients with at least one child (N=132) were randomly assigned to receive six weeks of nutrition education or delayed education. Participants completed the food behavior checklist, dietary recall and consented to a blood draw for serum nutrient levels before and after education. Results showed a significant correlation between the fruit and vegetable behavior questions and actual serum carotenoid levels (P<0.001). Milk, fat, cholesterol, fruit and vegetable checklist items also showed significant correlations with associated dietary variables of interest provided through dietary recall data (73).

Overall, education through EFNEP can improve diet through directly increasing the number of healthful food group servings and indirectly through providing the skills that are useful in preparing and purchasing healthy foods.

Sustainability of Benefits

EFNEP education can promote behavior change, and it may be associated with self-efficacy and self-esteem, an important aspect of maintaining behavior change. An intervention of Texas EFNEP education to 372 Hispanic (92%) women (97%) revealed that greater goal attainment was significantly associated with beneficial changes in food choice. Participants utilized goal attainment sheets and data collection included a 24-hour dietary recall and measurement of menu planning skills. Greater goal attainment was significantly associated with selection of lower fat and sugar foods and increased fruit and vegetable consumption and availability (P<0.05). Participants obtained 51% percent of the 14 listed goals (40). EFNEP education may promote goal attainment that sustains behavior change.

Supporting evidence for maintenance of behavior change beyond graduation from EFNEP is limited. However, researchers that have investigated this question have found participants do maintain the various behaviors that improve immediately after graduation. Arnold
et al. (2000) found that graduates (N=59) of New York State EFNEP programs improved significantly in 10 out of 12 measured food practices, with no significant change between graduation and one year later. Food practices maintained included running out of money for food less often, and shopping with grocery lists, planning meals, comparing food prices, preparing meals from scratch and using less processed foods more often (all P=0.00). After graduation from EFNEP, 86% percent of participants stated that they were more interested in nutrition and health, 68% believed food choices have changed ‘a-lot’ and 90% of these women believed that their families were in better health after completing EFNEP (44). In another study, graduates from EFNEP programs in Nebraska improved or maintained their behaviors (planning meals, shopping with list, comparing prices, running out of food less) at exit and six months afterwards (P=0.001)(35). Overall, this evidence provides support that EFNEP participation can aid in sustainable change in food practices that may beneficially affect resource management to improve food security and health.

Study results have shown that low-income populations that participate in EFNEP can improve resource management skills, dietary intake, and food insecurity. The culminating implication of improved general health and wellbeing can result from these changes that are encouraged and promoted through EFNEP.

Overall, food insecure populations are at higher risk of experiencing a broad array of negative health outcomes compared to food secure populations. However, change in food-related behaviors, including resource management skills and nutrition practices, is associated with increased food security status and improved health outcomes. Nutrition education is a potential solution that is associated with behavior change; programs such as EFNEP can provide this education to at risk populations. EFNEP participants are likely to be those most at risk of food insecurity; this population is an ideal subject group to test the effectiveness of EFNEP on food security status as well as the ability of the food affordability question set to measure food-management behaviors associated with food security. Research supporting the apparent
association between food-related behaviors attained through education and improved food security status is limited. Additionally, tools that measure the behaviors associated with food security could serve an important role in examining this association. By doing so, researchers can provide evidence to support the impact of nutrition education programs that target behaviors related to food security.
CHAPTER III

STUDY OBJECTIVES

The main objective of this study was to (1) evaluate the associations between food security, the ability to afford foods throughout the month, and food-related behaviors, and (2) assess the effectiveness of EFNEP in improving food security status, food-related behaviors and the ability to afford food among EFNEP participants in Massachusetts. Research questions and hypothesis described in Table 1. Specific objectives are as follows:

1. To test the food affordability questions against the six-item USDA FSM
2. To measure the effect of EFNEP participation on food security status.
3. To measure the effect of EFNEP participation on food-related behaviors (food-resource management behaviors and ability to afford food throughout the month).
CHAPTER IV
METHODS

Setting & Participants

Massachusetts (MA) has eight regional offices that administer University of Massachusetts Extension Nutrition Education Programs, including EFNEP. Low-income individuals who are SNAP participants or SNAP-eligible limited resource families with young children receive education through EFNEP. EFNEP educators provide a series of seven lessons to groups of low-income assistance-eligible participants titled “CHOICES: Steps Towards Health.” Participants learn to make healthy food choices, purchases and meals for their families. Lesson content includes food-resource management skills (food budgeting), nutrition and health practices (food preparation, physical activity) and food safety and storage skills. To be eligible for the study, participants had to be enrolled in CHOICES and purchase and prepare their own food. This research study included a pre/post survey of EFNEP participants and analysis of routinely collected pre/post EFNEP participant data from three regional offices in Massachusetts: Springfield, Fall River, and Lawrence. All research procedures were approved by the University of Massachusetts Amherst Institutional Board of Review.

Previous Work

In a related study, the principal investigator of this research held focus groups and interviews with EFNEP staff and participants to determine food security languages and experiences. The principal investigator and nutrition education program (NEP) leaders from around Massachusetts jointly developed questions that were intended to assess consistent ability to afford foods (food affordability questions) throughout the month. The research team further refined the questions after discussion and a focus group conducted with EFNEP participants.
Survey Development & Pilot Testing

We developed a survey that included the food affordability questions, and the six-item USDA FSM. We used the 30-day, rather than 12-month FSM, due to the relatively short time frame of the EFNEP classes (average time: 5 weeks) (Table 2).

We pre-tested the survey prior to the full study with a focus group of nine CHOICES participants in December 2012. Participants discussed the clarity and meanings of the four food affordability questions and received a $15.00 gift card to a local grocery store as compensation. The final survey included the six-item USDA FSM and four additional questions designed to capture food management behaviors associated with food insecurity. The survey was translated into Spanish, and participants completed it in the language of their choice.

Data Collection

We recruited participants on a rolling basis from qualified EFNEP groups as they convened, from December 2012-April 2013. A member of the study team was introduced by the EFNEP team leaders and/or educators who then explained the additional questions and the nature of the research. All willing and eligible participants completed a consent form to participate in the study. Participants received a $10 gift card to a local grocery store after completing each of the pre- and post-EFNEP surveys.

Participants completed the self-administered survey before and after EFNEP classes. EFNEP staff collected routine EFNEP data at the start and completion of classes, which included demographics, a measurement of household food sufficiency, nutrition practices, and food-resource management behaviors (Table 2).

Data Entry and Analysis

EFNEP staff entered routine EFNEP data following standard EFNEP data entry procedures. An approved member of the research team accessed and entered data into a separate research database. Responses to the additional questions and EFNEP data were double entered into Excel and checked for accuracy. All discrepancies were corrected by referring to the paper
surveys. A member of the research team assigned a unique study ID number to each participant’s survey to maintain confidentiality, and removed all personally identifying information from the data sets. A separate list linked names with ID numbers. The data sets were imported into IBM SPSS Statistics 21 for analysis.

**Dependent Variables**

Food security status of participants was determined using data coding methods as instructed by the USDA FSM to determine household food security status of participants: high, marginal, low, and very low food security (74). Food security status was further characterized into two groups: high food secure (1) or marginal, low, very low food secure (0) and high, marginal food secure (1) or low, very low food secure (0). Answers to food affordability questions were coded into two categories based on response to always, often true (1) or sometimes, never, don’t know (0). Responses to EFNEP behavior checklist questions of interest were coded into two categories based on response to almost always, most of the time (1) or sometimes, seldom, do not do (0).

Descriptive statistics for demographic information and food security distribution were calculated. We investigated the association between food affordability questions, EFNEP behavior checklist questions and food security status as measured by the USDA six-item FSM through chi-square analysis of pre-EFNEP data. McNemar’s test for paired proportions assessed the pre-post education change in food security, food-related behaviors and ability to afford foods throughout the month.

**Variable Definition**

Research Question 1: What is the association between food security status and food affordability questions?

1. Specific Aim 1: To measure the association between food security status and food affordability questions: chi-square
   a. Variable 1: food security status
b. Variable 2: food affordability questions

Research Question 2: What is the impact of participation in EFNEP on food related behaviors?

2. Specific Aim 2: To measure the effect of EFNEP participation on food security status:

McNemar

   a. Outcome Variable (Y) : change in food security status

   b. Independent Variable (X1): EFNEP participation (nutrition education)

Research Question 3: What is the impact of participation in EFNEP on food-related behaviors?

3. Specific Aim 3: To measure the effect of EFNEP participation on change in answers to food-affordability questions and EFNEP behavior checklist questions: McNemar

   a. Outcome Variable (Y) : always or often to food affordability questions, most almost or always to EFNEP behavior checklist questions

   b. Independent Variable (X1): EFNEP participation (nutrition education)
CHAPTER V

RESULTS

Pre-EFNEP Responses and Population Characteristics

Pre-Survey Testing

In the pre-testing, participants expressed no confusion or concern with three of the four questions in the focus group. Discussion elicited confusion around the wording of the last question, which required clarification of the meaning of ‘grocery cart’ and ‘SNAP benefits’. Wording of the question changed as indicated by italics.

11. Does your grocery cart looks the same when you go shopping right after you get paid or receive SNAP benefits as it does right before you get paid or receive SNAP benefits?

11. Right after you receive SNAP benefits (food stamps) or get paid, do you buy different foods?

11a. If you answered ‘yes’ to question 11: Right after you get paid or receive SNAP benefits, does it look healthier or less healthy than right before you get paid or receive SNAP benefits?

11a. Right after you receive SNAP benefits (food stamps) or get paid, do you buy healthier or less healthy foods?

11b. If you answered ‘yes’ to question 11: Right after you get paid or receive SNAP benefits, do you buy more, the same amount, or less fruits and vegetables, compared with right before you get paid or receive SNAP benefits?

11b. Right after you get paid or receive SNAP benefits (food stamps) or get paid, do you buy more fruits and vegetables, less fruits and vegetables or the same amount of fruits and vegetables?

Pre-EFNEP Data

The analysis of pre-EFNEP survey data (N=80) included all participants who successfully completed both the survey and EFNEP entry paperwork. The largest percentage of participants were classified as low food secure (35%). Almost half (41.3%) of the population was food insecure (low + very low food secure). The population was majority white, non-Hispanic/Latino women with a mean age of 32 years. Approximately 40% had completed the 12th
grade and 22.5% had less than a 12th grade education. Mean income was estimated at $869.96/month and the average households size was three. The majority of participants had children under five years of age (M=1). Full descriptive statistics are presented in Table 3.

We conducted correlation analysis to determine the association between the food affordability questions and EFNEP behavior checklist questions. No significance was seen between these variable sets and no further analysis of these questions was completed. Additionally, participants continued confusion indicated that question 11 answers were unreliable. This question was not included in analysis of data secondary to lack of significance in correlation analysis and multiple missing values for this question.

Of the entire pre-EFNEP population, three participants cancelled enrollment in the CHOICES course for a total of 77 participants who completed the EFNEP behavior checklist. Compared to individuals in households with in high food security, a greater percent of those with marginal, low and very low food security reported comparing prices almost always or most of the time (69.8% vs. 50%). A smaller proportion of those in food insecure households (marginal, low, very low) reported planning meals ahead of time (52.8%), shopping with a grocery list (39.6%) and thinking about healthy foods (71.7%) compared to the proportion of high food secure (54.2%, 45.8%, and 75% respectively). Individuals in households with marginal, low and very low food security were significantly more likely to report running out of food before the end of the month most almost always or most of the time compared to those with high food security (30.2% vs. 8.3%, P=0.044). Compared to individuals in food secure households (marginal, high), a greater percent of individuals in food insecure households reported almost always or most of the time to planning meals ahead (61.3% vs. 47.8%) and comparing prices (67.7% vs. 47.8%). A smaller proportion of those in food insecure households (low, very low) reported shopping with a grocery list (38.7%) and thinking about healthy foods (71%) compared to high or marginal food secure (43.5%, 73.9%). Individuals in households with low and very low food security were significantly more likely to report running out of food before the end of the month compared to
those in households with high and marginal food security (38.7% vs. 13%, P=.013). Full results of pre-EFNEP chi-square analysis are presented in Table 4.

**Food Affordability and Food Security (RQ1)**

Individuals in households with marginal, low and very low food security were significantly less likely to report being always or often able to afford healthy foods and the same kind of foods throughout the month than those in high food secure households (P=0.018 and P=0.022 respectively). A smaller proportion of those in households with marginal, low and very low food security reported always or often being able to afford fruits and vegetables throughout the month compared to those with high food security (63.6% vs. 84.0%). Compared to individuals in households with high and marginal food security, those in low and very low food secure households were significantly less likely to report always or often being able to afford healthy foods and fruits and vegetables all month long (P=0.007, 0.051). About 50% of those in households with low and very low food security reported always or often affording healthy foods all month long compared to 80.9% of high or marginally food secure households. Individuals in households with low and very low food security were less likely to report always or often affording the same kinds of foods compared to households with high and marginal food security (57.6% vs. 70.2%). Results described in Table 4 and depicted in Figures 2 and 3.

**Pre- Post-EFNEP Survey Comparison**

**EFNEP Education and Food Security (RQ2)**

A total of 60 participants completed both pre- and post-food security surveys (eight cancelled enrollment in CHOICES, 12 enrolled in CHOICES still in progress). After education, there was no change seen between the four categories of food security, or households categorized as very low, low, marginal or high food secure. The increase in percentage of households classified as high or marginally food secure after education who were classified as low or very low food secure before education was significant at the P=0.07 level (60% to 71.7%, P=0.065). Additionally, a greater percentage (46.7%) of households were classified as high food secure after
education that were classified as marginal, low or very low food secure before education (33.3%, 
P=0.115). Results are presented in Table 5 and Figures 4 and 5.

**EFNEP Education and Food Affordability (RQ3)**

The percentage of participants (N=60) that were more likely to report always or often
affording fruits and vegetables, the same kinds of foods, and healthy foods did not change
(P=0.774, P=0.267, P=0.648, respectively). Full results are presented in Table 5.

**EFNEP Education EFNEP Behavior Checklist (RQ3)**

Out of the 80 participants that completed the pre-EFNEP behavior checklist, 46
completed both pre- and post-EFNEP behavior checklist. Eight participants cancelled enrollment
in CHOICES, 12 participants enrolled in CHOICES class in progress, and 14 participants had
incorrectly entered or unavailable EFNEP data. After education, there was no significant change
in the percentage of those that reported comparing prices, shopping with a grocery list, thinking
about healthy foods or planning meals ahead of time. There was no significant change in the
percent of those that reported running out of food before the end of the month after education.
Full results are presented in Table 5.
CHAPTER VI
DISCUSSION

Our results indicate that compared to those in food secure households, individuals in food insecure households have a harder time affording self-identified ‘healthy’ foods, fruits and vegetables and the same kinds of foods throughout the month. We found improvements in food security status and desirable change in certain reported behaviors after EFNEP education, with no significant change in the ability to afford foods after education.

Depending on how we defined marginally food secure households (RQ 1), the significant difference in responses to food affordability questions varied between food secure and food insecure households. If individuals in marginally food secure households are considered food secure (as currently categorized by the USDA ERS), a significant difference exists between the ability to afford healthy foods and fruits and vegetables throughout the month between individuals in food secure and food insecure households. However, when considering marginally food secure as food insecure, a significant difference is seen between individuals in food insecure households that can afford healthy and the same foods but no longer fruits and vegetables throughout the month. Our results support findings and hypotheses about changes in dietary practices in times of food insecurity and give credibility to previous findings that individuals in marginally secure households have higher rates of obesity and weight gain than those in food secure households (10). These results further emphasize that marginal food security likely has health implications. Individuals in households classified as marginally food secure are ignored when considered in the same population of high food secure households, yet they are still at risk of the detrimental effects of food insecurity.

Results indicate that education may have an effect on food security status and possibly certain food related behaviors (RQ 2 and 3). It is possible that a less direct association exists between education and food security status, and that the true improvement in food security is an indirect effect of education to change behaviors or supply knowledge and skills that help to
improve food security. For instance, education that teaches how to stretch food and food dollars to avoid cyclic purchasing and consumption may improve the household’s ability to afford healthy food throughout the entire month. Improved ability to afford healthy foods to increase access and availability of these foods can help to negate poor health outcomes associated with increased consumption of less nutritious, low cost, energy dense foods (27). Additionally, no matter if we considered marginally food secure households as food secure or food insecure, the number of those classified as food secure increased after education. In other words, we saw increase of households with marginal food security to high food security as well as improvement from very low or low food security. This may indicate that even though USDA ERS definition and reporting considers individuals in marginally food secure households as food secure, those classified as marginal food secure may still benefit from education.

Common measurements of food insecurity mainly involve economic explanations, categorization and definitions. However, the ability to afford foods, particularly healthy foods, has nutritional and health outcomes that are not considered in economic definitions and indications of food insecurity. This research found that food insecure populations cannot afford fruits and vegetables throughout the entire month. Decreased consumption and availability of these foods may contribute to inadequate nutrient intake and increased consumption of other less healthful foods that could contribute to known weight gain or poor health outcomes seen in food insecure populations. Nutrition educators, researchers and professionals should consider food-resource management skills that improve one’s ability to afford food throughout the month. Educators of programs can then aim to lessen consequences of food insecurity through providing individuals and families with food-resource management knowledge, skills and behaviors.

Comparison with Previous Research

Previous research has indicated that food insecurity is associated with changes in dietary practices, including cyclic purchasing and eating (75). The apparent link between behaviors and
practices such as cyclic purchasing and consumption, the ability to afford foods and food security status is still unclear and multidimensional. However, no prior research has utilized food affordability questions to describe the association between ability to afford certain foods throughout the month and food security status as measured by the validated USDA FSM. Our research developed such questions and tested the ability to afford foods throughout the month and food security status at one point in time. Results provide important information about the relationship between food insecurity and ability to consistently afford healthy foods that is possibly associated with poor health outcomes. We were able to investigate possible associations between food-affordability questions and EFNEP behavior checklist responses. Although we found no significant correlations, there has been no prior research examining this particular relationship.

Previous researchers have utilized various measurement tools to investigate the impact of education on food security status, although limited studies exist (33). All researchers had significantly larger sample size compared to our study and found significant improvements in food security status. However, previous researchers have used a single food sufficiency question that does not measure food security as defined by the USDA FSM. Previous research indicates that multiple tools of measurement, including the six-item USDA FSM, can highlight the positive impact of education on food security. In our analysis, improvement in food security status from low/very low to marginal/high food security approached significance measured by the six-item USDA FSM.

Researchers have used methods to develop the questions included on the behavior checklist intended to measure participant’s behavior change after education. Researchers worked with EFNEP program sites and staff to develop questions appropriate to the population and curriculum. However, they did not indicate that EFNEP participants, who would be answering the questions, participated in focus groups (36). We are able to make improvements and changes to our questions based on feedback by EFNEP staff as well as EFNEP participants with the intention
to make the food affordability questions appropriate for measuring the ability to afford foods and to ensure readability and clarity.

Other researchers have used the EFNEP behavior checklist to measure behavior change after education in a small selection of literature. Researchers that found more significant changes in behavior checklist responses had larger sample sizes and used other methods of scoring responses, such as calculating a total score, using chi-square or paired t-tests (38). Researchers have found significant desirable changes in graduates alone and in those that receive education compared to those that do not (35, 37, 44). Additionally, participants maintain behavior change up to one year after exit from education (35). Given that we obtained approval for future communication from our participants, our study could utilize similar methods to assess maintenance or further improvements in behaviors (35). Our results did not indicate significant change in behavior checklist responses or food affordability responses after education, but we did note desirable changes in those reporting running out of food by the end of the month and thinking about healthy foods more often.

**Strengths & Limitations**

Strengths of the study include pre-testing of survey questions to improve clarity, appropriateness and general understanding. This process resulted in the elimination of one consistently misunderstood question, which can benefit from further revision for future use. We did not use this question in our analyses, but we captured similar themes with other questions that appeared to be well-understood. The entire 14 questions survey took approximately 10 to 20 minutes for participants to complete, with limited participant response burden.

Rates of food insecurity of our population were greater than the general U.S. population but comparable to other studies that focus on populations at risk of food insecurity. This makes our research applicable to similar populations most at risk. However, considering that some EFNEP participants may choose to enroll in the curriculum, they may be inherently different from those who are food insecure that do not choose to enroll in education. We were not able to
meet the initial goal sample size of 200, but we found significance associations between food-affordability, food security status and certain behavior checklist questions in pre-EFNEP analysis.

The pre-post study design without a control group limits comparisons to those that do not receive education. The cross-sectional nature of the pre-EFNEP analysis limits causality assumptions between the ability to afford food and food security. With this limitation, we do not know if food insecurity causes inability to afford foods or if the inability to afford food causes food insecurity. With a larger sample size, we could shed light on this relationship. Study design that includes a control group that receives delayed EFNEP education or a similar low-income population not enrolled in EFNEP could provide additional data to compare question responses or food security change over time. Additionally, we did not test the food-affordability questions in other low-income populations. It may be possible that those in EFNEP will be more conscious of nutrition and health and therefore think about healthy foods/fruits and vegetables more often or differently than those who do not enroll in EFNEP but are low-income. Administering the food-affordability questions to other low-income populations could provide further information on their applicability and use.

A limitation exists in the extent to which the food-affordability questions may be used in evaluating EFNEP education. Although we found a relationship between food security status and the food-affordability questions, this measurement represents one point in time and no significant change was seen in those that answered almost or always after EFNEP education. These questions may not be reflective of changes in behavior that may occur after education from the CHOICES program and therefore may not be applicable to measuring effectiveness of EFNEP education compared to the already developed behavior checklist. However, these questions may be beneficial in describing the food security status of participants along with the validated USDA FSM.

We chose to use the 30-day USDA FSM to assess food security status at pre- and post-EFNEP. We decided this was the more appropriate survey compared to using the 12-month FSM,
considering the EFNEP education took place between five and seven weeks. We cannot say if improvements in food security status or behavior change last beyond education at this time. However, participants indicated if they would allow us to contact them in the future for follow-up, providing the option for future research post-education.

**Implications and Future Research**

The results of this research support the proposed conceptual model introduced in this study. Individuals in food insecure households have a harder time affording foods, including healthy foods, throughout the month than individuals in food secure households. Whether food insecurity leads to cyclic behaviors or cyclic behaviors worsen food insecurity is unknown, but the results indicate that there is an association between the ability to afford foods and food security at one point in time (RQ 1).

Future researchers could utilize the food-affordability questions to describe the situation of food insecure households or at risk populations to strengthen the association between the ability to afford foods and food security. Studies that compare question responses in food secure vs. food insecure populations could further explain the differences in ability to afford foods. Although we did not see an improvement in the ability to afford foods after education, a larger sample size over a longer time may provide stronger results. Testing the questions in populations that receive education compared to those that have not received education could provide a comparison control useful for measuring affordability responses as well as EFNEP behavior checklist responses. Future studies may consider investigating if a greater number of adopted behaviors measured through the checklist improve food security to a greater extent.

Overall, considering the apparent relationship between food security and the behaviors measured through the EFNEP checklist, individuals in food insecure households may benefit from education around these behaviors and abilities. Improved abilities and resource management skills through education could indirectly improve food security status and ultimately decrease the
risk of poor health outcomes associated with food insecurity. Program designers should consider behaviors potentially tied to health outcomes, such as cyclic purchasing and consumption, in the design and improvement of current education programs. Providing knowledge and skills that offset detrimental behaviors and improve the ability to afford healthy foods throughout the entire month could help to combat the consequences of food insecurity.

Lastly, reporting services should consider the marginally food secure population as food insecure and therefore at risk of known health consequences. We found that food insecure households, including marginally food secure, are not able to afford healthy foods throughout the entire month. Education may have an impact on improving food security status, possibly indirectly by teaching behaviors, skills and knowledge of food and monetary resource management and nutrition practices.
Table 1: Research questions

<table>
<thead>
<tr>
<th>Research Question</th>
<th>Hypothesis</th>
<th>Sub-hypothesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. What is the association between food security status and food affordability</td>
<td>1.1 Ability to afford foods will be inversely related to food security</td>
<td>a. A smaller proportion of food insecure participants will report being able to always or often afford fruits and vegetables all month long</td>
</tr>
<tr>
<td>questions?</td>
<td></td>
<td>b. A smaller proportion of food insecure participants will report being able to always or often afford healthy foods all month long</td>
</tr>
<tr>
<td></td>
<td></td>
<td>c. A smaller proportion of food insecure participants will report being able to always or often afford the same kinds of foods all month long</td>
</tr>
<tr>
<td>2. What is the impact of participation in EFNEP on food security status?</td>
<td>2.1 Participation in EFNEP will lead to increased household food security status assessed by the six-item 30 day USDA FSM</td>
<td>a. Participation in EFNEP will lead to an increased percentage of individuals that are classified as high or marginal food security that were initially classified as having low or very low food security</td>
</tr>
<tr>
<td></td>
<td></td>
<td>b. Participation in EFNEP will lead to an increased percentage of individuals that are classified as high food security that were initially classified as having marginal, low, or very low food security.</td>
</tr>
<tr>
<td>3. What is the impact of participation in EFNEP on food related behaviors?</td>
<td>3.1 Participation in EFNEP will lead to improved food-resource management behaviors and nutrition practices using the EFNEP food behavior checklist</td>
<td>3.1 &amp; 3.2</td>
</tr>
<tr>
<td></td>
<td>3.2 Participation in EFNEP will lead to improved ability to afford foods all month</td>
<td>a. Participation in EFNEP will lead to increased percentage of individuals who engage in identified behaviors almost always or most of the time:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1. Plan meals ahead of time</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Compare prices before buying food</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Shop with a grocery list</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. Think about healthy food choices</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5. Run out of food</td>
</tr>
<tr>
<td></td>
<td></td>
<td>b. Participation in EFNEP will lead to an increased number of participants that engage in identified abilities always or often as measured by food-affordability questions</td>
</tr>
</tbody>
</table>
### Table 2: Food security survey components

<table>
<thead>
<tr>
<th><strong>Food Affordability Questions</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>We could afford to buy healthy foods all month long.</td>
<td></td>
</tr>
<tr>
<td>We could afford to buy fruits and vegetables all month long.</td>
<td></td>
</tr>
<tr>
<td>We could afford to buy the same kinds of food all month long.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>USDA six-item Food Security Module</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>The food that we bought just didn’t last, and we didn’t have money to get more.</td>
<td></td>
</tr>
<tr>
<td>We couldn’t afford to eat balanced meals.</td>
<td></td>
</tr>
<tr>
<td>In the last 30 days, did you or other adults in your household ever cut the size of your meals or skip meals because there wasn’t enough money for food?</td>
<td></td>
</tr>
<tr>
<td>In the last 30 days, how often did this happen?</td>
<td></td>
</tr>
<tr>
<td>In the last 30 days, did you ever eat less than you felt you should because there wasn’t enough money for food?</td>
<td></td>
</tr>
<tr>
<td>In the last 30 days, were you every hungry but didn’t eat because there wasn’t enough money for food?</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>EFNEP Behavior Checklist Questions</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Food security measure: How often do you run out of food before the end of the month?</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Resource Management Domain</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>How often do you plan meals ahead of time?</td>
<td></td>
</tr>
<tr>
<td>How often do you compare prices before you buy food?</td>
<td></td>
</tr>
<tr>
<td>How often do you shop with a grocery list?</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Nutrition Practices Domain</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>When deciding what to feed your family, how often do you think about healthy food choices?</td>
<td></td>
</tr>
</tbody>
</table>
Table 3: Demographic characteristics of pre-EFNEP study participants

<table>
<thead>
<tr>
<th>Pre-EFNEP Survey</th>
<th>N=80</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Food Security Status</strong></td>
<td>% (N)</td>
</tr>
<tr>
<td>High Food Secure</td>
<td>31.3 (25)</td>
</tr>
<tr>
<td>Marginally Food Secure</td>
<td>27.5 (22)</td>
</tr>
<tr>
<td>Low Food Secure</td>
<td>35.0 (28)</td>
</tr>
<tr>
<td>Very Low Food Secure</td>
<td>6.3 (5)</td>
</tr>
<tr>
<td><strong>Age (mean)</strong></td>
<td>32</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>13.8 (11)</td>
</tr>
<tr>
<td>Female</td>
<td>83.8 (67)</td>
</tr>
<tr>
<td><strong>Ethnicity</strong></td>
<td></td>
</tr>
<tr>
<td>Not Hispanic/Latino</td>
<td>52.5 (42)</td>
</tr>
<tr>
<td>Hispanic/Latino</td>
<td>45.0 (36)</td>
</tr>
<tr>
<td><strong>Race</strong></td>
<td></td>
</tr>
<tr>
<td>American Indian or Alaskan Native</td>
<td>1.3 (1)</td>
</tr>
<tr>
<td>White</td>
<td>71.3 (57)</td>
</tr>
<tr>
<td>Black or African American</td>
<td>15.0 (12)</td>
</tr>
<tr>
<td>Asian</td>
<td>7.5 (6)</td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td></td>
</tr>
<tr>
<td>&lt;Grade 12</td>
<td>22.5 (18)</td>
</tr>
<tr>
<td>Grade 12</td>
<td>37.5 (30)</td>
</tr>
<tr>
<td>GED</td>
<td>6.3 (5)</td>
</tr>
<tr>
<td>Some College/Graduated 2 Years College</td>
<td>25.0 (20)</td>
</tr>
<tr>
<td>Post Graduate</td>
<td>2.5 (2)</td>
</tr>
<tr>
<td><strong>Household Characteristics</strong></td>
<td></td>
</tr>
<tr>
<td>Monthly Household Income (mean, range)</td>
<td>$869.96, $0.00-$5000.00</td>
</tr>
<tr>
<td>Number of Participants with Children Between Ages:</td>
<td></td>
</tr>
<tr>
<td>0-5</td>
<td>30</td>
</tr>
<tr>
<td>6-13</td>
<td>21</td>
</tr>
<tr>
<td>14-19</td>
<td>17</td>
</tr>
<tr>
<td>Number of children (mean, range)</td>
<td>1, 1-5</td>
</tr>
<tr>
<td>Household size (mean)</td>
<td>3</td>
</tr>
</tbody>
</table>
Table 4: Association between pre-EFNEP survey responses and food security status

<table>
<thead>
<tr>
<th>Pre-EFNEP Analysis</th>
<th>Food Security Status</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Marginal/ Low/ Very Low Food Secure</td>
</tr>
<tr>
<td></td>
<td>(%) (n)</td>
</tr>
<tr>
<td>EFNEP Resource Management Questions (N=77)</td>
<td>N=53</td>
</tr>
<tr>
<td>Plan meals ahead almost always or most of the time</td>
<td>52.8 (28)</td>
</tr>
<tr>
<td>Compare prices almost always or most of the time</td>
<td>69.8 (37)</td>
</tr>
<tr>
<td>Shop with grocery list almost always or most of the time</td>
<td>39.6 (21)</td>
</tr>
<tr>
<td>Think about healthy foods almost always or most of the time</td>
<td>71.7 (38)</td>
</tr>
<tr>
<td>Run out of food before end of month almost always or most of the time</td>
<td>30.2 (16)</td>
</tr>
<tr>
<td>Food Affordability Questions (N=80)</td>
<td>N=55</td>
</tr>
<tr>
<td>Afford to buy healthy foods all month long always or often</td>
<td>60.0 (33)</td>
</tr>
<tr>
<td>Afford to buy fruits and vegetables all month long always or often</td>
<td>63.6 (35)</td>
</tr>
<tr>
<td>Afford to buy the same kinds of food all month long always or often</td>
<td>56.4 (31)</td>
</tr>
</tbody>
</table>

Results of chi-square analysis.*Significance at P<0.05
Table 5: Change in food security status and survey responses after education

<table>
<thead>
<tr>
<th>Food Security Status(N=60)</th>
<th>Pre-EFNEP % (n)</th>
<th>Post-EFNEP % (n)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Food Secure</td>
<td>33.3 (20)</td>
<td>46.7 (28)</td>
<td></td>
</tr>
<tr>
<td>Marginal Food Secure</td>
<td>26.7 (16)</td>
<td>25.0 (15)</td>
<td></td>
</tr>
<tr>
<td>Low Food Secure</td>
<td>35.0 (21)</td>
<td>25.0 (15)</td>
<td></td>
</tr>
<tr>
<td>Very Low Food Secure</td>
<td>5.0 (3)</td>
<td>3.3 (2)</td>
<td></td>
</tr>
<tr>
<td>High Food Secure (Marginal/Low/Very Low)</td>
<td>33.3 (20)</td>
<td>46.7 (28)</td>
<td>0.115</td>
</tr>
<tr>
<td>High/Marginal Food Secure (Low/Very Low)</td>
<td>60.0 (36)</td>
<td>71.7 (43)</td>
<td>0.065</td>
</tr>
</tbody>
</table>

**EFNEP Resource Management Questions (N=46)**

<table>
<thead>
<tr>
<th>Question</th>
<th>Pre-EFNEP % (n)</th>
<th>Post-EFNEP % (n)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plan meals ahead almost always or most of the time</td>
<td>56.5 (26)</td>
<td>50.0 (23)</td>
<td>0.648</td>
</tr>
<tr>
<td>Compare prices almost always or most of the time</td>
<td>65.2 (30)</td>
<td>76.1 (35)</td>
<td>0.180</td>
</tr>
<tr>
<td>Shop with grocery list almost always or most of the time</td>
<td>47.8 (22)</td>
<td>56.5 (26)</td>
<td>0.424</td>
</tr>
<tr>
<td>Think about healthy foods almost always or most of the time</td>
<td>67.4 (31)</td>
<td>80.4 (37)</td>
<td>0.070</td>
</tr>
<tr>
<td>Run out of food before end of month almost always or most of the time</td>
<td>20.0 (9)</td>
<td>8.9 (4)</td>
<td>0.180</td>
</tr>
</tbody>
</table>

**Food Affordability Questions (N=60)**

<table>
<thead>
<tr>
<th>Question</th>
<th>Pre-EFNEP % (n)</th>
<th>Post-EFNEP % (n)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Afford to buy healthy foods all month long always or often</td>
<td>68.3 (41)</td>
<td>63.3 (38)</td>
<td>0.648</td>
</tr>
<tr>
<td>Afford to buy fruits and vegetables all month long always or often</td>
<td>66.7 (40)</td>
<td>70.0 (42)</td>
<td>0.774</td>
</tr>
<tr>
<td>Afford to buy the same kinds of food all month long always or often</td>
<td>68.3 (41)</td>
<td>76.7 (46)</td>
<td>0.267</td>
</tr>
</tbody>
</table>

Results of McNemar analysis. *Significance at P ≤ 0.05
Figure 1: Conceptual Model
Figure 2: Low/very low vs. high/marginal food security responses to food affordability questions

Figure 3: Marginal/low/very low vs. high food security responses to food affordability questions
Figure 4: Effect of education on low/very low food security

Figure 5: Effect of education on marginal/low/very low food security
BIBLIOGRAPHY


