A default option for health: improving nutrition with the financial and geographic constraints of food insecurity

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A DEFAULT OPTION FOR HEALTH:
IMPROVING NUTRITION WITHIN THE FINANCIAL AND GEOGRAPHIC
CONSTRAINTS OF FOOD INSECURITY

by

Jaime A. Coffino

A Dissertation
Submitted to the University at Albany, State University of New York
In Partial Fulfillment of the Requirements for the Degree of
Doctor of Philosophy

College of Arts & Sciences
Department of Psychology
2020
DEDICATION

This dissertation is dedicated to my parents,

Robert Coffino

and

Sharyn Coffino

who gave me the nudge I needed to believe in myself.
ACKNOWLEDGEMENTS

I would like to thank my graduate advisor, Dr. Julia Hormes, for telling me that my ideas are interesting and worth pursuing from the very first day of graduate school. I am grateful that you encouraged me to work on research projects that I am passionate about and supported me as I became a better researcher. I would also like to thank my committee members, Dr. Drew Anderson and Dr. James Boswell, for providing me with guidance on this project.

Thank you to Rachel Luba and Rae Drach who are loyal friends and colleagues and supported the completion of this project in numerous ways.

Thank you to Gloria Han who had the kindness and patience to teach me linear mixed effects modeling after full days on internship. Thank you for being an outstanding friend and colleague.

I would also like to thank Dr. Whitney Evans for improving this project by providing training and guidance on how to analyze nutrition data. Additionally, I would like to thank Dr. Rena Wing for allowing me to complete this project using resources at the Weight Control and Diabetes Research Center.

I would like to acknowledge the funding for this project provided by the USDA Center for Behavioral Economics and Health Food Choice Research (BECR Center) at Duke University and the University of North Carolina at Chapel Hill. This project would not have happened without this support from the Healthy Food Behavior Research Grant.

Lastly, but most importantly, I would like to thank my parents, Sharyn and Robert Coffino, and my grandparents, Judith and Robert Schilsky, for supporting me throughout this entire journey and for always making me feel like I could accomplish anything I set my mind to. I am confident I was only able to pursue this degree because of your love, support, and guidance.
Abstract

Food insecurity, the limited availability of nutritionally adequate food, is associated with increased risk for obesity and associated health problems. There is a crucial need for sustainable interventions that improve diet-related health in individuals with food insecurity. In behavioral economics, the default option is the option a consumer obtains if they do not make an active choice. The current study aims to improve the nutritional quality of groceries purchased online by individuals with food insecurity with the use of a prefilled online grocery shopping cart (i.e., a default option). Over the course of five weeks, food pantry users \((n = 38)\) purchased approximately $48.50 worth of groceries using a local store’s online website. The first time participants purchased groceries online (T0: baseline) they were instructed to keep in mind nutrition, cost, and taste. For the subsequent four shopping timepoints (T1-T4), participants were randomized to receive nutrition education or a prefilled online grocery shopping cart that met their nutritional needs based on sex and age. From baseline to T1, participants in the Default condition had an immediate, significant increase in Healthy Eating Index (HEI) scores (i.e., a measure of diet quality) and a significant decrease in total calories and energy density of foods purchased. Overall, these differences were maintained throughout the treatment period (T1-T4). In the Default condition, initial improvement in HEI scores was maintained throughout the treatment period. Calories and energy density of foods purchased significantly increased in the Default condition throughout the intervention, but these values were always lower (i.e., indicating healthier grocery purchases) compared with the Nutrition Education condition. In the Nutrition Education condition, initial levels of HEI scores, calories, and energy density, indicating significantly less healthy grocery purchases, were maintained (i.e., no significant increase or decrease) from the beginning to end of treatment. These results provide preliminary evidence that the use of a default option while online
grocery shopping can improve food purchasing behavior in individuals with food insecurity and significant budgetary constraints. Implementation of this intervention via online platforms may specifically benefit those living in food deserts with limited access to healthy options.

*Keywords:* online grocery shopping; default option; choice architecture; food insecurity; nutrition
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Chapter 1: Introduction

Many food pantry users live with food insecurity, which is defined as the inability to acquire nutritionally adequate food due to insufficient resources (Coleman-Jensen, Rabbitt, Gregory, & Singh, 2019). Evidence suggests that individuals with food insecurity are at an elevated risk of having overweight or obesity. Obesity (body mass index $\geq 30$ kg/m$^2$) affects approximately 40% of individuals living in the United States (Hales, Carroll, Fryar, & Ogden, 2017). Prevalence rates are highest among minority groups, individuals with lower levels of education, and children in families where household income is at or below the poverty level (Center for Disease Control [CDC], 2016; Mokdad et al., 2003). Obesity is associated with a myriad of negative mental and physical health outcomes including depression, hypertension, and cardiovascular disease (Hubert, Feinleib, McNamara, & Castelli, 1983; Kahn, Hull, & Utzschneider, 2006; Re, 2009; Reilly et al., 2003; Stunkard, Faith, & Allison, 2003; Yaturu, 2011). Thus, reducing the rates of obesity in the United States is of significant public health interest.

The elevated risk of overweight and obesity in individuals with food insecurity likely results from many complex, interacting factors. Previous studies note that a lack of financial resources and insufficient transportation and time are important barriers to healthy eating in this population (Dhurandhar, 2016). Given these barriers to purchasing healthy food, it is particularly important for researchers to develop feasible and sustainable interventions for individuals with significant financial constraints. Current interventions aimed at targeting healthy eating in
individuals with food insecurity include providing nutrition information and incentives for healthy eating. However, there is concern that these intervention approaches are not effective or sustainable (An, 2015; Leung et al., 2013).

A small but growing body of research demonstrates that default options (i.e., pre-set options a consumer obtains if they do not decide otherwise) can encourage consumers to make healthier food choices without requiring them to make an active choice (Thaler and Sunstein, 2008). For example, interventions have utilized default options in restaurant settings to make healthy food choices more readily available to consumers (e.g., an entrée automatically comes with a side salad instead of fries). Recent research aimed at improving diet quality in individuals with food insecurity utilized this default approach in the form of an online grocery shopping cart prefilled with a healthy selection of groceries (Coffino, Udo, & Hormes, 2020). Results from this study demonstrated that compared to reviewing nutrition education, participants who received a prefilled online grocery shopping cart purchased: significantly more whole grains, fruits and vegetables; foods that were higher in fiber; and foods that were lower in calories, fat, saturated fat, sodium, and cholesterol (Coffino et al., 2020). This study by Coffino and colleagues (2020) provided preliminary evidence that online grocery shopping may serve as a platform to disseminate default-option interventions to promote healthy eating while simultaneously helping individuals with food insecurity overcome geographic, financial, and educational barriers to healthy eating.

The present study is the first longitudinal randomized control trial to examine if an online prefilled grocery shopping cart (i.e., a default cart) nudges individuals with food insecurity to purchase healthier groceries compared to receiving nutrition education. Furthermore, the present study sought to extend the prior findings by Coffino and colleagues (2020) by (1) examining the
nutritional quality of groceries purchased using a more comprehensive index of nutritional quality, and (2) examining whether any immediate positive effects can be maintained over a longer intervention period.

**Chapter 2: Background**

**Food Insecurity and Obesity**

Food insecurity was initially conceptualized as the lack of access to food, but over the years the definition has expanded to address the importance of the availability and access of obtaining a healthy variety of foods (Coleman-Jensen et al., 2019; Pinstrup-Andersen, 2009). Food insecurity affects approximately 37.2 million Americans, which equates to approximately 14.3 million American households (Coleman-Jensen et al., 2019; Gundersen & Ziliak, 2015). Considering the high prevalence of food insecurity in the United States, researchers and policymakers have sought to examine its determinants, the causal effects of food insecurity on negative health outcomes, and the impact of food assistance programs (Gunderson, Kreider, & Pepper, 2011).

There is evidence to suggest that a hunger-obesity paradox exists in which individuals with food insecurity are more likely to have obesity (body mass index (BMI) of at least 30 kg/m²; Dinour, Bergen, & Ming-Chin, 2007). Obesity is a major public health concern in the United States with prevalence rates as high as 18.5% in youth and 39.8% in adults (Hales et al., 2017). Obesity is associated with many adverse physical and mental health outcomes and increases in all-cause mortality (Di Angelantonio et al., 2016; Flegal, Kit, Orpana, & Graubard, 2013; Scott, McGee, Wells, & Browne, 2008; Kessler et al., 2013). The most recent estimates suggest that the cost burden of obesity in the United States is approximately $149.4 billion per year (Kim & Basu, 2016).
There are several hypotheses to explain the hunger-obesity paradox. The resource scarcity hypothesis suggests that when an individual has food insecurity and simultaneous access to energy dense foods, excess food intake occurs (Dhurandhar, 2016). Specifically, the lower cost of energy-dense food compared to fresh produce may contribute to weight gain in individuals with food insecurity (Dinour et al., 2007). For example, low income populations purchase a high percentage of sugar-sweetened beverages and are less likely to consume the recommended amount of fruits and vegetables, compared to those with higher income and education (Andreyeva, Luedicke, Henderson, & Tripp, 2012; Patterson, Oldenburg, & Gould, 2002; Turrell, Hewitt, Patterson, Oldenburg, & Gould, 2002). Furthermore, the lack of resources, time, and education often seen in individuals with food insecurity contributes to elevated risk of obesity (Dhurandhar, 2016).

Although there are many studies that demonstrate the presence of the hunger-obesity paradox, other work suggests no significant relationship between food insecurity and adult weight status (Holben & Pheley, 2006; Laraia, Siega-Riz, & Evenson, 2004; Webb, Schiff, Currivan, & Villamar, 2008; Whitaker & Sarin, 2007). In a systematic review, six out of eight cross-sectional studies found no clear association between food insecurity and obesity among men; for women, six of thirteen cross-sectional studies also concluded no clear association between household food security and obesity (Larson & Story, 2011). This inconsistency suggests a need for further research.

There are contributing factors, such as marital status, maternal stressors, race/ethnicity, and hunger, that may help explain inconsistent findings regarding the hunger-obesity paradox. For example, divorced men with food insecurity are at an increased risk of obesity compared to never married men (Hanson, Sobal, & Frongillo, 2007). Additionally, research has demonstrated
that as maternal stressors increase in low-income households, the likelihood of a child being overweight also increases (Gunderson, Lohman, Garasky, Stewart, & Eisenmann, 2008). There are also inconsistent findings around race/ethnicity. Several studies demonstrate a significant relationship between food insecurity and obesity in non-Hispanic White and Hispanic groups, but this relationship is not seen as often in non-Hispanic Blacks (Bhattacharya, Currie, & Haider, 2004; Franklin et al., 2012). Furthermore, Kaiser, Townsend, Melgar-Quinonez, and Crawford (2004) explored the role of hunger in the relationship between food insecurity and obesity. They found that food insecurity with hunger (i.e., the uncomfortable physical sensation caused by lack of food) was significantly associated with obesity, but no association was found among those who had food insecurity without hunger (Kaiser et al., 2004). Despite inconsistent findings on the hunger-obesity paradox, the overall elevated rates of food insecurity and obesity in the United States suggest a need for interventions targeting unhealthy eating.

**Barriers to Healthy Eating in individuals with Food Insecurity**

There are financial, geographic, and educational barriers individuals with food insecurity face that make it more difficult to purchase healthy food. Researchers and interventionists must take these barriers into account when developing interventions targeting diet and weight-related health in this population.

**Financial barriers.** It is commonly hypothesized that individuals with food insecurity decrease food costs by selecting inexpensive and often lower quality foods (Dinour et al., 2007; Seligman, Davis, Schillinger, & Wolf, 2010). A meta-analysis examining if healthy foods cost more found the largest price difference by healthfulness in meats and other proteins, with the healthier option being approximately $.29 more expensive per serving (Rao, Afshin, Singh, & Mozaffarian, 2013). Other food and drink groups such as grains, snacks/sweets, fats/oils, and
soda/juice also showed a price differential by healthfulness ranging from $.02 to $.12, with healthier options consistently costing more than unhealthy products. These studies suggest that lowering the price of healthy foods can potentially reduce consumption of unhealthy food and increase diet-related health. Additionally, these studies demonstrate the importance of educating people on how to identify low-cost healthy food items (e.g., beans, legumes).

**Geographic barriers.** Food deserts, defined as underprivileged urban areas where residents cannot buy affordable or healthy food, have contributed to negative health outcomes in low-income communities (Cummins & Macintyre, 2002). Residents of food deserts are often forced to spend substantially more money on items purchased at local corner stores and bodegas because chain supermarkets are not readily accessible (Short, Guthman, & Raskin, 2007). Large supermarkets, which often offer cheaper and healthier food items than convenience stores, are less frequently located in rural, low income communities (Larson, Story, & Nelson, 2009; Morton & Blanchard, 2007; Powell, Slater, Mirtcheva, Bao, & Chaloupka, 2007). Low-income neighborhoods are also more likely to have fast food restaurants, which have been shown to increase access to high-fat foods resulting in weight gain in residents of those neighborhoods (French, Harnack, & Jeffery, 2000; Jeffery & French, 1998). Additionally, neighborhoods with larger racial minority populations are less likely to have access to supermarkets (Galvez et al., 2008; Morland, Wing, Roux, & Poole, 2002; Zenk et al., 2005). Specifically, Morland and colleagues (2002) found that supermarkets are four times more common in predominately white neighborhoods compared to predominantly black neighborhoods. Further research is needed to explore the factors that contribute to the consumption of less healthy food in people located in rural, low-income, minority communities, and urban food deserts within the United States.
**Educational barriers.** Studies have found that many individuals with low-income lack sufficient knowledge of nutrition to properly understand what constitutes a healthy diet (Boulanger, Perez-Escamilla, Himmelgreen, Segura-Millan, & Haldeman, 2002; Eikenberry & Smith, 2004; Robinson, 2008). Eikenberry and Smith (2004) found that low-income respondents were able to identify fruits and vegetables as an important component of a healthy diet, but that they overall were not able to adequately define what it means to eat healthy. There is also evidence to suggest that individuals with food insecurity disproportionately struggle with nutrition literacy. Nutrition literacy is the ability to comprehend basic nutrition information (e.g., reading a nutrition label) to make informed decisions. In a study that assessed nutrition literacy in low-income Hispanic women, 62% reported that they had either never read a nutrition label or did not know how to read a nutrition label (Boulanger et al., 2002). Based on these results, future research should assess whether the inability to interpret nutrition labels leads to poorer health outcomes in low-income populations and individuals with food insecurity.

**Supplemental Nutrition Assistance Program (SNAP)**

In order to address these barriers, the federal government adopted the Supplemental Nutrition Assistance Program (SNAP) to increase the ability to purchase food and address hunger and malnutrition within individuals with food insecurity. SNAP, previously referred to as the “Food Stamp Program,” was developed by President Roosevelt during the Great Depression due to the need to distribute excess farm commodities. President Roosevelt’s “New Deal” included the Agricultural Adjustment Act of 1933, which provided farmers with additional income as well as food to those in need. On May 16th, 1939, the first person participated in the Food Stamp Program (Landers, 2007). The original Food Stamp Program ended in 1943 with the substantial economic growth seen after World War II. In 1961, John F. Kennedy initiated a
successful food stamps pilot program with the United States Department of Agriculture (USDA), which enabled Congress to approve Lyndon B. Johnson’s recommendation to make the Food Stamp Program permanent. The Food Stamp Act of 1964 passed, which allowed people to purchase stamps equivalent to the average amount of money they spent on food as well as additional stamps to obtain low-cost and nutritionally adequate food (Landers, 2007).

Today, SNAP is the largest federal government program offering food assistance, with more than 46 million individuals and 22 million families participating (Richard & Sindelar, 2013), costing the government approximately $65 billion in 2018 (USDA Food and Nutrition Service, 2019). SNAP allows anyone who meets eligibility requirements based on financial need to receive benefits. These eligibility requirements are based on poverty thresholds, which were originally developed in 1955 by: (1) examining the Household Food Consumption Survey, which measures how much money families spend on food after taxes, and (2) the economy meal food plan, which determines the most inexpensive food deemed nutritionally adequate (Landers, 2007). The current poverty thresholds for SNAP benefits vary by state. For example, in the state of New York a one-person household has to earn less than $15,444 per year and a four-person household has to earn less than $31,590 per year to qualify for benefits (“New York State”, 2018).

There are many benefits to participating in SNAP, such as being provided with nutrition information and resources to obtain nutritionally adequate food. A national representative study found that SNAP participation reduced the likelihood of being “food insecure” by approximately 30% and of being “very food insecure” by 20% (Ratcliffe, McKernan, & Zhang, 2011). Other studies found that SNAP participation is associated with an increased likelihood of having food insecurity or that it has no effect on food security status (Huffman & Jensen, 2008; Wilde &
Nord, 2005). However, Wilde and Nord (2005) discuss how other confounding factors, such as unforeseen negative circumstances, may influence food security status and program participation, but that overall food stamp participation in itself should not negatively impact food security status (Wilde & Nord, 2005).

Although it appears that SNAP has helped many individuals with food insecurity access food, the program does not appear to have successfully accomplished its goal of improving diet-related health. A cross-sectional study using the 1994-1996 Continuing Study of Food Intakes of Individuals found that participating in the Food Stamp Program was associated with a 38% increase in the likelihood of being overweight in women, but not in men (Townsend, Peerson, Love, Achterberg, & Murphy, 2001). Limitations of this study include the cross-sectional design and the lack of consideration of confounding variables such as history of poverty and food insecurity (Townsend et al., 2001). Gibson (2003) aimed to address these limitations by using data from the National Longitudinal Survey of Youth to examine long-term participation in the Food Stamp Program as well as sociodemographic characteristics. Compared to no participation in the Food Stamp program, current and long-term participation were significantly related to obesity for low-income women (Gibson, 2003). Specifically, current participation in the Food Stamp Program was associated with a 9.1% increase in the predicted probability of current obesity whereas participation in the Food Stamp Program in the previous five years was associated with a 20.5% increase in the predicted probability of current obesity (Gibson, 2003).

A study by Leung, Willett, & Ding (2011) lends support to previous findings that SNAP participation is associated with an increased risk of obesity by measuring BMI and other diet- and weight-related health indicators such as waist circumference, triglyceride levels, cholesterol, glucose, and metabolic syndrome. The sample consisted of nonelderly, low-income adults (n =
2250) from the National Health and Nutrition Examination Survey (NHANES) cross-sectional survey by the National Center for Health Statistics. Results demonstrated that SNAP participation was associated with greater obesity risk, increased waist circumference, elevated triglyceride levels, lower HDL cholesterol, elevated fasting glucose, and metabolic syndrome (Leung et al., 2011).

Based on the available data, it is evident that there is an association between SNAP participation and obesity. These findings are particularly consistent among women participating in the program. One possible explanation for this association is that SNAP participants may spend more money on food while enrolled in the program because SNAP provides them with additional funds, which may result in increased food consumption. Additionally, SNAP participation does not address many barriers to purchasing healthy food faced by this population, including geographic barriers. Due to the association between SNAP participation and obesity, researchers and policymakers have called for sustainable interventions to reduce obesity rates and improve diet-related health in low-income communities and particularly among SNAP recipients.

**Interventions Targeting Diet-Related Health in Low Income Communities**

**Nutrition Education.** Interventions targeting nutrition education in low-income communities have focused on increasing nutrition knowledge to alter objective indicators of health such as weight. Research has been conducted specifically among SNAP recipients to examine whether graduating from the Expanded Food and Nutrition Education Program (EFNEP) or Supplemental Nutrition Assistance Program-Education (SNAP-Ed) result in an increase in nutrition and health knowledge (Koszewski, Sehi, Behrends, & Tuttle, 2011). The EFNEP originated in the 1960s and aims to improve the health of people with low
socioeconomic status through nutrition and food safety lessons, information of how to eat healthy on a budget, and increased access to resources. SNAP-Ed began in Wisconsin in the 1980s and promotes specific health and diet recommendations such as consuming fruits and vegetables on a daily basis and eating fat-free or reduced fat dairy products (Koszewski et al., 2011). Research has shown that participants in SNAP-Ed and EFNEP who completed a minimum of six nutrition and food budgeting classes improved on 13 out of 15 of their self-reported health behaviors (e.g., “how often do you shop with a grocery list?”) six months post education programming (Koszewski et al., 2011). Furthermore, Wardlaw & Baker (2012) assessed long-term self-reported behavior change among SNAP recipients in the EFNEP program and found that people maintained most positive changes up to three years after graduation from the program.

Additionally, research has examined modifications of the EFNEP to determine whether modifications to the program affect participant outcomes. For example, low-income mothers participating in EFNEP reported increased consumption of fruits, calcium, vitamin A, and vitamin C, regardless whether the program was administered in 12 face-to-face sessions or in self-administered video format (Cox, White, & Gaylord, 2003). Similarly, Cullen and colleagues (2009) found that regardless of modification to the EFNEP (i.e., regular EFNEP classes versus six videos with handouts), improvements were reported in dietary behaviors for both groups. Of note, there was a decrease in BMI in the video intervention group at the end of treatment; however, this was not sustained at follow-up (Cullen et al., 2009). Lastly, when EFNEP programming was compared in individual versus group format, self-reported dietary behaviors improved significantly more in the individual format (Dollahite & Scott-Pierce, 2003).
Although research has shown an increase in health behaviors in low-income communities and SNAP recipients as a result of these interventions, these studies are not without limitations. Many education interventions are based on self-report questionnaires or analyzing the purchasing of food items, which insufficiently capture actual food consumption. For example, outcomes commonly examined are often based only on self-report behavior checklists pre- and post-program participation. These surveys include questions such as, “how often do you plan your meals?”; “how often have you prepared food without adding salt?”, and “how often do you wash your hands before preparing food?” (Koszewski et al., 2011). It is important to note that studies in low-income communities that did observe changes in nutrition knowledge and self-reported food frequency typically did not document changes in important objective measures of health such as BMI and blood cholesterol (Howard-Pitney et al., 1997). Other potential limitations may include costs associated with these programs and difficulty of individuals with food insecurity accessing these programs in remote areas.

**Calorie labeling.** The United States has increasingly enacted food policy that aims to increase healthful food choice and decrease diet-related illnesses in the general population. Specifically, the Patient Protection and Affordable Care Act requires that chain restaurants include nutrition labeling at their restaurants (Bollinger, Leslie, & Sorensen, 2011). In 2008, New York City became the first city to implement this policy in chain restaurants with 15 or more locations nationwide. These restaurants are required to display the caloric content of food and drink items on their menus and menu boards. In one study, researchers gathered data from Starbucks in New York City and found that displaying the calories on the menu caused average calories purchased to decrease by 6% per transaction, with effects largest for high calorie consumers (Bollinger et al., 2011). Another study on nutrition labeling at Subway restaurants
found that customers who saw nutrition information consumed on average 52% fewer calories (Bassett et al., 2008). Conversely, Harnack and colleagues (2008) found that when presented with menus with calories versus no calories at fast food restaurants, the calorie content of meals purchased was not significantly different (842 vs. 827 kcs). Overall, a systematic review on calorie-labeled menus found that only two out of the seven included studies reported a reduction in calories (Swartz, Braxton, & Viera, 2011).

Furthermore, studies focusing on the impact of nutrition labeling in low-income, minority communities found no significant differences in calories of meals purchased when comparing purchasing pre- and post-implementation of the calorie labeling legislation (Elbel, Kersh, Brescoll, & Dixon, 2009). One study specifically targeted 14 fast food restaurants with caloric labeling in low-income communities and five control restaurants without calorie labeling. Data was collected pre- and post-calorie labeling in the 14 experimental restaurants and results found that calorie labeling had no impact on calories per transaction (Elbel et al., 2009). Although there were no significant differences, 27.7% of participants who saw the calorie label reported that it influenced their food decisions and 88% of these participants noted that it influenced their decision to purchase foods with lower calorie content.

Although some studies found calorie labeling reduced the caloric purchasing of food items, it is difficult to generalize these findings to individuals with food insecurity (Bollinger et al., 2011). Additionally, the previously mentioned study specifically conducted in low-income communities, found no change in the caloric content of purchases once calories were displayed on menus (Elbel et al., 2009). It is possible that in this population factors such as cost and convenience may be more important than nutrition content. Individuals with food insecurity may even be inclined to purchase foods with higher caloric content if they are concerned about where
their next meal is coming from. Additionally, it is possible that this population has more difficulty interpreting nutrition information due to lower education and nutrition literacy issues. Due to inconsistent findings, more research is warranted to determine if calorie labeling has an effect on food purchasing and food consumption.

**Incentives.** To increase the consumption of healthy food in individuals with food insecurity, researchers have posited that providing subsidies for the purchase of healthy foods such as fruits and vegetables may increase the consumption of these products. The Health Incentives Pilot Program was launched by the USDA Food and Nutrition Service with the aim of increasing fruit and vegetable consumption among SNAP recipients. Specifically, the pilot program tested whether a 30% incentive for purchasing “targeted” fruit and vegetables would increase the purchasing of these items. Targeted fruits and vegetables included fresh, dried, canned, or frozen fruits and vegetables that do not have added sugars, fats, oils, or salts (Klerman, Bartlett, Wilde, & Olsho, 2014). After purchasing a targeted fruit or vegetable, the 30% incentive was added to the SNAP participants Electronic Benefit Transfer (EBT) card. Based on dietary recall, four to six months after the pilot launched, participants in the Healthy Incentives Pilot reported purchasing 24% more fruits and vegetables than SNAP participants not participating in the Health Incentives Pilot (Klerman et al., 2014). Of note, this study specifically examined the purchasing of fruits and vegetables but did not track the actual consumption of produce.

Furthermore, a large randomized control trial measured reported fruit and vegetable consumption 9-11 months after the implementation of the Healthy Incentives Program and found that participation increased targeted fruit and vegetable consumption by approximately 26% (Olsho, Klerman, Wilde, & Bartlett, 2016). There was also a significant decrease in consumption
of refined grains likely due to the increase in fruit and vegetable consumption. There are important implications for the increase in fruit and vegetable consumption as it has been linked to reductions in morbidity and mortality (Bazzano et al., 2002). Specifically, if a 30% subsidy on fruit and vegetable purchases increased consumption by 26%, this could potentially reduce incidence of type 2 diabetes by an estimated 10.3%, myocardial infarction by 8.5%, stroke by 7.4%, and obesity by 1.3% in SNAP participants (Choi, Seligman, & Basu, 2017).

A qualitative study asked experts their opinion on addressing the barriers to healthy eating in the SNAP community, and they agreed that incentives might prove an effective method to increase the consumption of healthy food (Leung et al., 2013). However, one key limitation to providing SNAP recipients with incentives to purchase healthier food items is the fact that it will be costly to the government to provide these incentives. Another key limitation is that it is difficult to assess whether the increased purchases of fruit and vegetables would result in overall excess food consumption. Specifically, though fruit and vegetable consumption may increase with the use of incentives, if this consumption is added to overall intake rather than as a replacement for unhealthy food, it is unclear whether the effects will be beneficial. If the ultimate goal is to reduce obesity rates and improve diet-related health, it would not be ideal for SNAP recipients to be consuming additional calories. Therefore, other strategies have been suggested such as placing bans and restrictions on certain unhealthy food and drink items.

**Restrictions/bans.** It has been suggested that policies that rely on restriction of unhealthy food and drink products may lower the rate in which SNAP participants purchase unhealthy items. Policymakers have proposed restrictions on the use of SNAP benefits on many occasions, but in 2010 New York City proposed a pilot study examining the health benefits of restricting the purchase of sugar-sweetened beverages (SSBs) among SNAP participants (Schwartz, 2017).
Although this request was denied by the USDA, the topic of restricting purchases while using SNAP benefits continues to be a topic of debate.

It has been argued that a ban on SSBs would significantly reduce obesity prevalence rates and the incidence of type II diabetes (Basu, Seligman, Gardner, & Bhattacharya, 2014). Researchers used a microsimulation model of BMI and type 2 diabetes risk and calculated how a ban on SSBs would affect the prevalence and incidence of these chronic illnesses. Researchers predicted that a ban on SSB purchasing by SNAP beneficiaries would reduce caloric intake of SSBs by 15.4%, which results in approximately 24.2 calories per SNAP recipient per day (Basu et al., 2014). Using a 10-year simulation model, the decline in weight would average to 1.14 lbs. per person, which would ultimately result in a decline in obesity prevalence rates by 2.4% (422,000 people). Additionally, according to the model, the incidence rate of type II diabetes would decline on average by 8.5 per 1000,00, which is a 1.7 percent decline among SNAP participants (240,000 people; Basu et al., 2014).

The results of this study should be interpreted with caution because the statistical model is based on assumptions; there is no method to precisely and accurately predict how a ban on SSBs would affect consumption. Furthermore, the statistical model relied solely on estimation of food consumption to determine obesity prevalence rates and type 2 diabetes incidence rates. This is problematic because there are other factors in addition to food consumption that affect these rates. The study also only examined the proposed policy’s impact on obesity and type II diabetes when there are other chronic illnesses associated with poor nutrition. Lastly, the model cannot take into account implementation barriers that might negatively affect this population as well as the stigma around the loss of freedom associated with a ban.
Overall, there has been debate as to whether it is ethical to place restrictions on unhealthy food items for SNAP participants, as placing restrictions on an already vulnerable and marginalized population may result in additional stigmatization. Researchers further suggested that the SSB ban would particularly affect racial and ethnic minority groups and those aged 18-65 (Basu et al., 2014) and that implementing item restrictions within SNAP is unethical in limiting an individual’s right to choose (Chrisinger, 2017). Implementing this type of restrictive policy sends a message that this population is not capable of making informed decisions, which could even result in decreased participation in SNAP. Additionally, there is research to suggest that a restriction may not lower consumption of SSBs but may in fact increase the consumption of other unhealthy food items (Todd and Ploeg, 2014). There is also an argument that restricting the purchase of SSBs could result in a “slippery slope,” in which other food items deemed unhealthy would also be banned from purchase or taxed at a higher rate (Schwartz, 2017). Furthermore, it is also difficult to determine how successfully item restriction could be employed even if the federal government did pass a ban on SSBs.

**Default Options to Nudge Consumer Behavior**

The limitations of previously discussed interventions (i.e., nutrition education, calorie labeling, incentives, and restrictions) to improve healthy eating warrant new and innovative intervention approaches. Research has begun to gather inspiration from other fields of research, such as behavioral economics, to create new approaches to improve healthy eating.

Behavioral economics combines the fields of economics and psychology to examine how people deviate from standard economic models due to irrational decision-making (Sent, 2004). Within the realm of behavioral economics is the concept of choice architecture, defined as altering the context in which people make decisions, which can include changing the physical
environment (i.e., the placement of food items) in order to influence which choices are presented to consumers (Thaler, Sunstein, & Balz, 2014; Bucher et al., 2016). The default option, an aspect of choice architecture, is referred to as the option a consumer selects if they do not make an active choice. Default options aim to influence behavior while simultaneously respecting an individual’s freedom of choice (Sunstein & Thaler, 2003). The default option is based on the concept of libertarian paternalism and takes advantage of the assumption that people tend to take the path of least resistance (Thaler et al., 2014). The default option is often seen in the context of opt out versus opt in, in which the default option suggests a particular course of action for an individual without requiring them to actively participate (Johnson et al., 2012).

The default option is supported by social psychological theories such as loss aversion and the status quo bias (Kahneman, Knetsch, & Thaler, 1991). Loss aversion is based on the idea that people have a more difficult time giving up an object than acquiring it (Kahneman et al., 1991). To test this concept, Loewenstein and Kahneman (1991) conducted an experiment in which half of the students in a classroom were given pens as gifts and the other half were given tokens that they could redeem for an unknown gift (i.e., six potential gifts including the pen as one of them). The participants then ranked the attractiveness of the six potential gifts but were eventually told they could choose between a pen and two chocolate bars. For the participants who started off with a pen, 56% chose to keep the pen, whereas only 24% of the other participants chose a pen. Of note, when examining the attractiveness ratings of the gifts, the subjects that began the experiment with pens did not rate them as more attractive. This suggests that the main effect of endowment is the discomfort of giving up the pens and not the fact that they found the pens to be more attractive (Loewenstein & Kahneman, 1991).
The concept of loss aversion has been seen in many domains such as the housing market and individual stock returns (Barberis & Huang, 2001; Genesove & Mayer, 2001). With regard to housing markets, loss aversion has been shown to impact whether a seller decides to accept or decline an offer on their house. For example, people who are loss averse may set a higher asking price and keep their house on the market as opposed to selling it for what it is worth (Genesove & Mayer, 2001). Furthermore, Barberis & Huang (2001) demonstrated that investors in individual stock portfolios may also be loss averse and sensitive to reductions in their personal wealth. This is especially true depending on the portfolio’s prior fluctuations.

People also tend to possess a status quo bias, which is defined as the preference to keep things as they are (Kahneman et al., 1991). The status quo bias was demonstrated in an experiment in which participants were given a hypothetical choice task about how to invest money. In the hypothetical choice task there is one group in which a status quo is defined and another in which no status quo is defined. In the “no status quo” condition, participants were told that they should assume that they understand how to read financial pages and that they need to consider different portfolio options. The participants are then given multiple choices in which they can choose how to invest their money. In the “status quo” condition, participants were confronted with the same problem, but one specific investment option in a moderate risk company was deemed as the status quo. The results of the experiment showed that when an option was shown as the status quo, it became significantly more popular among participants. Results have also found that the decision to choose the status quo increases with the number of alternative options (Samuelson and Zeckhauser, 1988).

The concept of the status quo bias has been studied in other domains such as health care services and insurance policies (Salkeld, Ryan, & Short, 2000; Johnson, Hershey, Meszaros, &
Kunreuther, 1993). For example, Johnson and colleagues (1993) demonstrated that a consumer’s choice of insurance policy depended on what used to be the legislative status quo in that particular state, even after the law was changed. Additionally, Salkeld and colleagues (2000) demonstrated that when consumers are given the choice of an existing versus a new bowel cancer testing program, they preferred the existing service. Overall, the status quo bias allows us to understand that when people are making decisions, they prefer to keep things the way they are.

The default option has gained attention as a way to facilitate decision making in a wide variety of domains including enrollment in 401k plans, organ donation, and energy efficiency (Madrian & Shea, 2001; Johnson & Goldstein, 2003; Brown, Johnstone, Haščič, Vong, & Barascud, 2013; Coffino & Hormes, 2018). People may be more inclined to choose the default option due to insufficient time to investigate alternative options or the perception that the default option was chosen to benefit the public (Thaler & Sunstein, 2003). For example, certain European countries have a default policy in which people are registered as organ donors unless they specifically register to opt-out of organ donation (Johnson & Goldstein, 2003). Even when they do opt-out of organ donation, they are required to make phone calls and fill out paperwork. When researchers examined the organ donation consent rates in European countries with an opt-out versus opt-in method of enrollment, there was an approximate 60% difference in enrollment rate, which results in millions of more donations and potential lives saved (Johnson & Goldstein, 2003).

**Default Options and Food Choice**

With the increasing evidence of the use of a default option in a variety of health domains, researchers have begun to examine whether the default option can positively influence food choice. The use of the default option has been shown to effectively increase the consumption and
purchase of healthy food in a variety of settings. Van Kleef and colleagues (2018) demonstrated that when making whole wheat bread the default option at a university food stand, nearly all participants (94%) decided to keep the whole wheat bread option. Similarly, when white bread was set as the default option a majority of participants (80%) decide to keep the white bread option (Van Kleef et al., 2018). Furthermore, Loeb and colleagues (2017) found that when parents are given a default option for their child’s breakfast, they were likely to remain with that option for their child. Specifically 82% of parents remained with the less healthy breakfast for their child if that was the default and 97% remained with the healthy breakfast if that was their default (Loeb et al., 2017).

Since there is preliminary evidence that interventions utilizing default options and choice architecture can effectively nudge individuals to make healthier decisions in a variety of food settings, research has expanded to examine whether the default option can be successfully used to nudge individuals to make healthier decisions while grocery shopping. For example, the purchasing of fruits and vegetables increased in a grocery store when they were displayed more prominently (Walmsley, Jenkinson, Saunders, Howard, & Oyebode, 2018). Another study launched a Healthy Kids Campaign, which altered the point-of-purchase food environment by increasing the exposure of fruits, vegetables, and healthy snacks. Over half of the participants (58%) reported that they bought healthier food due to the kiosk (Holmes, Estabrooks, Davis, & Serrano, 2012). Examples of items that increased in sales during this period included whole-wheat bagels, bananas, radishes, honey, sunflower seeds, baked tortilla chips, and almond butter.

**Default Options in the Context of Online Grocery Shopping**

With the rise of online grocery shopping, recent research has focused on nudging grocery shopping behavior on an online platform. The potential benefits of online grocery shopping are
vast, including the ability to disseminate interventions widely to individuals with food insecurity living with geographic constraints. With the majority of low-income Americans owning a smartphone (“Mobile Fact Sheet”, 2018), online grocery shopping can potentially be implemented broadly within this population. There is limited evidence of using choice architecture to nudge healthy foods on an online platform but the research appears promising. Huang and colleagues (2006) demonstrated that if online shoppers received automated advice to choose products lower in saturated fat, compared to receiving more general advice, they were significantly more likely to replace their original food items with items lower in saturated fat, with an overall reduction in saturated fat of 10%.

Furthermore, two online grocery shopping pilot studies were conducted to help inform the current study. The first proof-of-concept study found that presenting undergraduate students with a prefilled “default” online grocery shopping cart enhanced healthy grocery selection (Coffino & Hormes, 2018). This study aimed to nudge participants into selecting healthier groceries on a budget that is typical of individuals receiving the maximum allowance of SNAP benefits in the state of New York (i.e. $48.50/week). The only instructions the participants were given was to select “nutritious, affordable, and tasty groceries for a week” within the budget of $48.50. The participants were randomly assigned to receive nutrition education adapted from SNAP-Ed programming brochures, to be presented with a prefilled online grocery shopping cart in which they were free to make changes as desired, or to receive a $10 incentive if they selected groceries that met recommended macro- and micronutrients (Coffino & Hormes, 2018). Results demonstrated that participant assignment to the Default condition, compared to the Nutrition Education condition, resulted in a significant increase in budget allocated towards fruits, and a decrease in average daily calories, saturated fat, and sodium content of foods selected. There
were no differences in all nutrition outcomes between the Default and Incentive conditions. This was the first study to examine whether a prefilled online grocery shopping cart could positively influence *food selection* under financial constraints.

The second pilot study was conducted to test if a prefilled online grocery shopping cart can be utilized to nudge individuals with food insecurity into making healthier *food purchases* (Coffino, Udo, & Hormes, 2020). This study aimed to compare the impact on the healthfulness of food purchases with use of a prefilled shopping cart while online grocery shopping, compared to receiving nutrition education. Compared to receiving nutrition education, the prefilled online grocery shopping cart (i.e., default option) resulted in a significant increase in the purchases of servings of whole grain, fruits and vegetables, daily fiber, and a decrease in average daily calories, daily grams of fat, saturated fat, and daily sodium and cholesterol content. This was the first study to examine whether a default option is effective in increasing healthy food purchasing in individuals with food insecurity (Coffino et al., 2020). This study suggests that an online default approach may help improve food choice behaviors in individuals with food insecurity with significant financial constraints.

**Aims and Hypotheses**

This present study expands upon the previously described studies by Coffino & Hormes (2018) and Coffino and colleagues (2020) by examining whether the default option, compared to receiving nutrition education, improves the diet quality of online grocery purchases made by individuals with food insecurity over the course of a month. It was hypothesized that the prefilled online grocery shopping cart (i.e., default condition) will result in a significant improvement in the nutritional quality of groceries purchased compared to those receiving nutrition education. Secondary aims of this study include the examination of directly measured weight, nutrition
knowledge, and nutrition literacy (i.e., the ability to read a nutrition label) pre- and post-intervention to determine whether receiving nutrition education or a prefilled online grocery shopping cart results in increased nutrition knowledge, nutrition literacy, and a decrease in weight.

Chapter 3: Methods

The Institutional Review Board at the University at Albany, State University of New York reviewed and approved this study (protocol #17E224). Study participants were informed of the nature and purpose of the research and provided informed consent prior to completion of questionnaires and the experimental tasks. Participants were told that they could discontinue participation in the study at any time without any adverse consequences to them.

Participants

Participants \((n = 38)\) were recruited from three local food pantries in upstate New York. Participants were required to meet the following eligibility criteria: (1) age 18+, (2) receiving assistance from a food pantry, (3) single person household, (4) able to give informed consent, (5) no major dietary restrictions (i.e., gluten free, vegetarian/vegan, or lactose intolerance), and (6) no current eating disorder as assessed via the SCOFF screening measure (with a score \( \geq 3 \) used as a cut-off score in this present study; Morgan, Reid, & Lacey, 1999). Participants also verbally confirmed that they considered themselves to have food insecurity and were provided with the following definition: “Food insecurity is the limited or uncertain availability of nutritionally adequate and safe foods or limited or uncertain ability to acquire acceptable foods in socially acceptable ways” (Anderson, 1990). Participants were not required to receive SNAP benefits to participate in this study. Participants were required to be of a single person household and have no major dietary restrictions for ease of creating a default cart, to facilitate analysis of their
grocery shopping purchases, and to increase likelihood that they are consuming the foods purchased.

**Measures and Baseline Characteristics**

Baseline measures included information about participants’ demographics, eating behaviors and preferences, nutritional knowledge, and grocery shopping experiences. To examine group differences in factors that could potentially influence primary outcomes participants completed the U.S. Food Security Model, assessing level of food security (Cronbach’s $\alpha = .83$ in the present sample; National Center for Health Statistics, 2008); the Binge Eating Scale (BES), a measure of binge eating severity ($\alpha = .85$; Gormally, Daston, & Rardin, 1982); the Dutch Eating Behavior Questionnaire (DEBQ), which measures emotional ($\alpha = .97$), external ($\alpha = .87$), and restrained eating styles ($\alpha = .90$; Van Strien, Frijters, Bergers, & Defares, 1986); and the Food Neophobia Scale (FNS), a measure of willingness to try novel foods ($\alpha = .55$; Pliner, & Hobden, 1992). Participants also completed the Newest Vital Sign (NVS), a measure of nutrition literacy ($\alpha = .84$; Weiss, 2005) and the Social Desirability Scale (SDS), an assessment of social desirability ($\alpha = .79$; Crowne & Marlowe, 1960) (see Table 1 for demographic characteristics and baseline measures).

**Study Intervention**

The present study is a randomized controlled trial in which participants purchased groceries online and had them delivered to their place of residence at five time points. At the baseline visit (Timepoint 0), participants were provided with no instructions other than to purchase $48.50 in groceries online for their own consumption using a local grocery store’s website. For the four subsequent visits (time points 1-4) participants were randomized to the Nutrition Education or Default condition (see Figure 1 for participant flow diagram). During
each of these visits, participants completed online questionnaires and were asked to purchase $48.50 in groceries after being presented with nutrition education (i.e., nutrition education materials from SNAP programming) or a prefilled grocery shopping cart. Participants in the Nutrition Education condition were given different handouts at timepoints 1-4 (see Table 2 for nutrition education brochure titles and examples of nutrition education content and Appendix 1 for a sample of the nutrition education brochures given to participants). Participants in the Default condition were instructed that they could keep all the items in their cart, delete all of the items in their cart, or change whichever items they wanted but that the prefilled grocery cart was meant to represent a nutritionally balanced grocery shopping cart based on their sex and age (see Appendix 2 for Default Cart Example).

**Creation of the Default Cart**

The default carts were created using the Thrifty Food Plan Calculator (TFPC). The TFPC, developed by the USDA and in collaboration with the Tufts University Gerald J. and Dorothy Friedman School of Nutrition Science and Policy, provides comprehensive information on caloric, macronutrient, and micronutrient content of the foods selected based on participant age and sex as a function of the total amount of money spent (Wilde, Llobrera, & Campbell, 2008). To determine the nutrition quality of the default cart, each food or drink item was placed into the appropriate category in the TFPC (i.e., low cost poultry, whole grain pasta and rice) to generate the nutrition output. The algorithm that determines the nutritional quality of foods purchased is based on the price, consumption, and nutrition data from the United States Department of Agriculture’s (USDA) official 2006 Thrifty Food Plan and 2005 MyPyramid recommendations. The recommended daily food quantities generated by the TFPC were chosen to be as similar as possible to the average consumption of low-income Americans, while
simultaneously meeting our cost target of $48.50 (i.e., maximum weekly SNAP benefits for a single adult in New York), nutrition standards, and recommended levels for broad categories of foods (i.e., fruits, and vegetables) and macronutrients (i.e., saturated fat, fat, carbohydrates, protein) per USDA’s guidelines.

**Dietary Assessment**

At all timepoints (T0-T4), participant grocery cart purchases were saved for analysis and subsequently coded as diet records using the Nutrition Data Systems for Research (NDSR; 2018), developed by the Nutrition Coordinating Center (NCC), University of Minnesota, Minneapolis. Each food or drink item was identified or nutrient-matched within the NCC Food and Nutrient Database, which provides data on nutrient composition for over 18,000 foods, including 7,500 brand name foods and beverages (Schakel, 2001). NDSR output files were then used to determine total energy intake (kcal) and energy density (kcals/gram) for each cart. Diet quality, as measured by the Healthy Eating Index, 2015 (HEI-2015) total scores, was also calculated for each cart using SAS code developed specifically for NDSR output files. The HEI-2015, which is density-based (per 1,000 calories), is a measure of diet quality that assesses adherence to the Dietary Guidelines 2015-2020 (DGA) as a total score that ranges from 0 to 100, with higher scores indicating better diet quality (Krebs-Smith et al., 2018).

**Secondary Outcomes**

Nutrition literacy, nutrition knowledge, and objectively-measured weight were assessed pre-and post-intervention (T0 and T4).

*Newest Vital Sign (NVS).* The NVS examines nutrition literacy by assessing the competency of reading a nutrition label with six open-ended questions. Participants were shown a picture of a nutrition label for a container of ice cream and asked the following six questions: 1.
If you eat the entire container, how many calories will you eat?, 2. If you are allowed to eat 60g of carbohydrates as a snack, how much ice cream could you have?, 3. Your doctor advises you to reduce the amount of saturated fat in your diet. You usually have 42 grams of saturated fat each day, which includes 1 serving of ice cream. If you stop eating ice cream, how many grams of saturated fat would you be consuming each day?, 4. If you usually eat 2500 calories in a day, what percentage of your daily value of calories will you be eating if you eat one serving?, 5. Is it safe for you to eat this ice cream?, 6. Why not? (ask only if the patient responds “no” to question 5).

General Nutrition Knowledge. The following questions were taken from the USDA’s website and were used to assess participants’ general nutrition knowledge: 1. Which nutrient provides energy?, 2. Which of the following is a good source of protein?, 3. True or False: Dietary guidelines recommend people drink whole milk instead of low fat milk., 4. True or False: Dietary guidelines count a glass of unsweetened fruit juice as a serving of fruit., and 5. True or False: Dietary guidelines suggest that at least half of all grains eaten should be whole grains. These questions have not previously been validated but were included in this study to broadly assess nutrition knowledge.

Statistical Analyses

Data were analyzed using SPSS Version 25, R Version 3.5.3 and R Studio Version 1.0.143. Primary outcome variables consisted of the Healthy Eating Index (HEI), total calories (kcal), and energy density (kcal/g) of each online cart across five timepoints (T0: baseline; T1: Week 1 of intervention; T2: Week 2 of intervention; T3: Week 3 of intervention; and T4: Week 4 of intervention). At each timepoint and for all outcomes, extreme outliers (defined as > 3 times the interquartile range for each outcome at each timepoint) were identified and corrected using a
standard Winsorization procedure where values > 3 times the interquartile range were adjusted to the next highest value (Wilcox, 2005). For all measures, skewness and kurtosis fell between -2 and +2 at all timepoints except for total calories, which was significantly right-skewed and kurtotic. Consistent with previous work (Coffino & Hormes, 2018), total calories were log transformed to accommodate normality assumptions in subsequent statistical procedures. After corrections, all Shapiro-Wilk tests of normality were nonsignificant (all p’s > 0.05).

Longitudinal data were analyzed using linear mixed effects (LME) models (Raudenbush & Bryk, 2002), with five time points nested within each individual. Missing data was of minimal concern as 92% of participants had complete observations and LME procedures also accommodate missing data through full maximum likelihood estimation. Subject-specific random effects were determined using restricted maximum likelihood estimation (REML) and population-level fixed effects with full maximum likelihood estimation. Because timepoints were equally spaced, we specified an autoregressive lag-1 (AR1) autocorrelation structure to model the covariances across timepoints.

As participants were first assessed at baseline (T0) and then randomly assigned to either the Nutrition Education or Default condition for the four-week treatment period (T1 – T4), we specified time in a piecewise manner to capture changes in outcome variables during conceptually meaningful periods of the study: Pre-Treatment (Piece 1: T0 to T1) and Active Treatment (Piece 2: T1 to T4). This specification of time in the piecewise LME framework allowed us to estimate separate coefficients and slopes for these two informative time periods in the same model for each outcome variable. To examine differential treatment effects over time, we were particularly interested in testing the two-way Treatment (Nutrition Education vs. Default) x Time interaction during the Pre-Treatment (Piece 1) and Active Treatment (Piece 2)
periods. First, random effects for variation at the intercept and in the slope for Piece 1 and Piece 2 were entered into each model and retained when significant. At the second step, we entered fixed effects for Piece 1, Piece 2, Treatment Condition (Nutrition Education vs. Default), and the Treatment x Piece 1 and Treatment x Piece 2 interactions, into the model. All models included age, sex, and BMI as covariates based on previous studies testing this concept by Coffino & Hormes (2018) and Coffino and colleagues (2020).

Power analyses appropriate for longitudinal data (Diggle et al., 2002) were conducted to determine the necessary sample size in each treatment group to detect treatment group differences during the Pre-Treatment and Active-Treatment periods. Previous work has indicated that the mean difference in nutrition outcomes in the Nutrition Education and Default conditions were likely to yield large effect sizes (Cohen’s $d$ range from 0.80 to 1.6) (Coffino et al., 2018). Thus, we calculated the necessary sample size to detect large effect sizes for between-group comparisons (Cohen’s $d = 1.00$) with $p < 0.05$ two-tailed $\alpha$, a correlation of $r = 0.60$ between repeated measures, and 80% power. Results indicated a desired sample size of $n = 12.6$ per treatment condition during the Pre-Treatment period and $n = 22.0$ per treatment condition during the Active Treatment period. The present study was sufficiently powered for the pre-treatment period, with some potential concerns regarding power for the active treatment period.

**Chapter 4: Results**

**Demographic and Baseline Characteristics**

Participants were on average 48 years old ($M = 47.53$, $SD = 14.24$, range: 20-71) and approximately half of the sample (52.60%, $n = 20$) identified as male. Participants reported a wide range of BMIs (range 19.37 - 44.62 kg/m²) with 83.70% ($n = 31$) reporting a BMI in the
overweight or obese category. Over half of the sample had attended at least some college (58.30%, n = 21) and a majority of participants identified as non-white (71.10%, n = 27).

On average, participants at baseline received $35.87 in SNAP benefits (range $0-$192) per month. Nearly all participants reported that they cook/prepare their own meals at least often or always during the week (81.60%, n = 31) and most participants reported that they have a budget specifically for grocery shopping (72.20%, n = 26) with an average weekly budget of $46.40 (SD = $28.74). Nearly all participants had access to a kitchen (94.70%, n = 36) and approximately half of participants had access to a computer (55.30%, n = 21) in the place they reside. Most participants (78.90%; n = 30) reported that they would consider buying groceries online. Treatment groups did not significantly differ on key demographic variables and measures, including age, BMI, sex, race, education, food security status, social desirability scale scores and all eating-related measures (see Table 1 for full list of measures).

At baseline, participants average HEI scores were 53.95 (SD = 13.22) and they consumed 14,956.16 (SD = 8382.67) weekly calories with an average energy density of 1.44 (SD = .50). Average participant weight at baseline was 196.09 lbs (SD = 51.31) and they answered 2.13 out of 6 questions correctly on the NVS (SD = 2.16) and answered 3.27 out of 5 questions correctly on the questions assessing general nutrition knowledge (SD = 1.33). There were no significant differences by treatment condition at baseline for primary and secondary outcome variables.

**Grocery Consumption**

At T1, participants reported consuming 81.66% (SD = 18.09) of the groceries purchased and 38.90% of participants reported buying additional groceries during the week. At T2, participants reported consuming 77.74% (SD = 22.01) of the groceries purchased and 47.20% of participants reported buying additional groceries during the week. At T3, participants reported
consuming 80.57% (SD = 25.52) of the groceries purchased and 36.10% of participants reported buying additional groceries during the week. At T4, participants reported consuming 73.88% (SD = 33.23) of the groceries purchased and 41.20% of participants reported buying additional groceries during the week. There were no significant differences in the consumption of groceries purchased between treatment conditions at all timepoints (all p’s > .05).

**Default Cart**

During the active treatment period (T1-T4), participants had between 19-21 items in their default cart (prefilled carts tailored based on participant sex and age). At T1, participants removed on average 53.53% (11.24 items; SD = 5.94) of their cart and added an average of 7.29 items (SD = 4.40). At T2, participants removed on average 60.12% (11.94 items; SD = 5.83) of their cart and added 7.59 items (SD = 4.46). At T3, participants removed on average 68.47% (14.29 items; SD = 6.22) of their cart and added approximately 9.00 items (SD = 4.95). At T4, participants removed on average 64.19% (13.47 items; SD = 7.00) of their cart and added 7.53 items (SD = 4.58).

**Differential Treatment Effects on Primary Outcomes**

Table 2 presents results from the piecewise linear mixed effects models. As described in Table 2 and depicted in Figures 2, 3, and 4, significant Treatment (Nutrition Education vs. Default) x Time interaction effects were found for Healthy Eating Index (HEI), total calories [log(kcal)], and energy density (kcal/g). As a reminder, a significant interaction in this context indicates a difference in slopes in the Default compared to Nutrition Education condition. Specifically, the interaction was significant during the Pre-Treatment (Treatment x Piece 1) and Active Treatment (Treatment x Piece 2) periods for both log-transformed calories [Pre-Treatment: t(134) = -2.89, p = 0.004; Active Treatment: t(134) = 3.11, p = 0.002] and energy
density [Pre-Treatment: $t(135) = -2.25, p = 0.02$; Active Treatment: $t(135) = 2.38, p = 0.02$]. Of note, results did not differ when using raw total calories as the outcome variable. For HEI, the two-way interaction was only significant during the Pre-Treatment period [$t(135) = 2.92, p = 0.004$].

Examination of slopes during the Pre-Treatment period (T0 to T1) revealed that participants assigned to the Default condition demonstrated a significantly positive and increasing slope in HEI (Slope = 16.59, 95% CI = [9.79, 23.39]) and significant negative and decreasing slope in total calories (Slope for Raw Calories = -6,303, 95% CI = [-10,942, -1,663]; Slope for log(Calories) = -0.16, 95% CI = [-0.27, -0.06]) and energy density [Slope = -0.37, 95% CI = [-0.70, -0.04]]. This effect was not seen in the Nutrition Education condition, for which the slopes from baseline to the start of treatment did not significantly differ from 0. As detailed in Table 3, simple effects (Winer, Brown, & Michaels, 1971) were computed at each timepoint and showed that significant between-treatment group differences were maintained across the first two weeks of the treatment period (T1 to T2) for all primary outcomes.

During the Active Treatment period (T1 to T4), slopes for the Nutrition Education condition were again not significantly different from 0, indicating negligible change over time. Significant Treatment x Piece 2 (Active Treatment) interaction effects were primarily driven by positive slopes for changes in total calories (Slope for Raw Calories = 1,456, 95% CI = [600, 2,311]; Slope for log(Calories) = 0.04, 95% CI = [0.02, 0.08]) and energy density (Slope = 0.14, 95% CI = [0.04, 0.25]). Importantly, though these slopes reflect an increasing trend from the beginning to end of treatment, values at the end of treatment in the Default condition never reached the same level of the Nutrition Education condition. Examination of significant
covariates indicated that being female was associated with lower number of calories in their online grocery shopping cart \[t(32) = 2.6, p = 0.01\].

**Secondary Outcomes**

*The Newest Vital Sign.* There were no significant baseline differences between the Nutrition Education \((M = 2.00, SD = 2.11)\) and Default condition \((M = 2.26, SD = 2.26)\) in the ability to read a nutrition label \(p = .71\). The ability to read a nutrition label nominally increased from T0 to T4 in both conditions \(+.24 M\) increase in the Nutrition Education and Default conditions) but there were no significant differences in improvement in scores between conditions \(p = 1.00\).

*General Nutrition Knowledge.* There were no significant baseline differences between the Nutrition Education \((M = 3.28, SD = 1.49)\) and Default condition \((M = 3.26, SD = 1.19)\) in the average number of correct responses to nutrition knowledge questions \(p = .97\). Nutrition knowledge increased from T0 to T4 in the Nutrition Education condition \((M = +.17, SD = 1.10)\) and nominally increased in the Default condition \((M = +.18, SD = 1.38)\) but there were no significant differences in improvement in scores between conditions \(p = .42\).

*Objectively-measured Weight.* Participants’ objectively-measured weight did not significantly differ at baseline \[Nutrition Education: \(M (SD) = 192.04 (53.68);\) Default: \(M (SD) = 200.36 (49.84); p = .63\]\. Participants in both the Nutrition Education and Default condition experienced minimal weight change from T0 to T4 \((M_4-M_0 = +0.43\) pounds, \(SD_{diff} = 3.91\); \(M_4-M_0 = +0.45\) pounds, \(SD_{diff} = 4.89\), respectively) with no significant differences in weight change between conditions \(p = .99\).
Chapter 5: Discussion

The current randomized controlled trial tested the differential effects of a prefilled online grocery shopping cart compared to a nutrition education control condition on indices of health in online grocery purchases over the course of one month. Results indicated that from baseline to the beginning of treatment, participants in the Default condition had an increase in HEI scores (i.e., a measure of diet quality) and a decrease in total calories and energy density, demonstrating immediate positive effects on the diet quality of grocery purchases. For example, baseline HEI scores in the Default condition were 51 which is approximately 13 points lower than the national average (Kennedy, Ohls, Carlson, & Fleming, 1995); however, HEI scores ranged from 61 to 68 throughout the intervention, indicating scores that are comparable to and even surpassing the national average. Furthermore, at the beginning of the intervention period, weekly calories decreased by 6,303 kcal from baseline in the Default condition and increased by 4,003 kcal in the Nutrition Education condition. This type of reduction in weekly calories in the Default condition can potentially impact weight and weight-related illnesses if effects are maintained over time.

In addition to assessing initial treatment effects, we also examined the extent to which effects endured or changed throughout the one-month treatment period. Within the longitudinal framework, we examined this in two ways: 1. Simple effects analyses to assess between-condition differences at each timepoint, and 2. Assessment of whether or not slopes significantly differed from 0 during the active treatment period. First, examination of differences in primary outcomes at each timepoint demonstrated that initial between-group differences were maintained at the second week of the intervention period. Next, examination of slopes revealed that, in the Nutrition Education condition, HEI scores, calories, and energy density did not significantly increase or decrease from the start to the end of the active treatment period, suggesting that
receiving nutrition education prior to purchasing groceries online did not significantly change grocery purchasing behavior over time. In contrast, in the Default condition, HEI scores exhibited a decreasing and non-significant trend, and calories and energy density gradually and significantly increased throughout the active treatment period. Importantly, despite these changes in HEI scores, calories, and energy density throughout the active treatment period in the Default condition, values never reached the same level of the Nutrition Education condition, reflecting overall healthier grocery purchases in the Default compared to the Nutrition Education condition over the course of the month.

These findings can be interpreted in light of the originating choice architecture principle of “nudging” consumers to make healthier choices. Specifically, participants in the Default condition had autonomy to make their own shopping decisions but were successfully nudged in a healthier direction compared to individuals who were not oriented towards healthier options. In fact, those who did not receive “nudges” (i.e., participants in the Nutrition Education condition) did not exhibit any changes in behavior and purchased consistently less healthy groceries over time.

A closer examination of grocery shopping behavior revealed that participants in the Default condition consumed, on average, 76.12% of their purchased groceries. Additionally, on average, participants in the Default condition removed over half of the groceries (range 53.53%-68.47%) in their prefilled cart in lieu of other, more preferred items. This suggests that they did not simply accept the cart provided to them but made changes based on their dietary preferences. In other words, participants maintained their freedom and autonomy to make choices based on personal dietary preferences and were successfully nudged to make healthier food choices compared to those who were not given the nudge. Moreover, the active changes made to the
prefilled grocery shopping cart can be framed in favor of sustainability of the default option, as the intervention was accepted and feasibly implemented in a vulnerable population of individuals with food insecurity.

**Secondary Outcomes**

Participants’ nutrition knowledge increased by approximately 25% with no significant differences by treatment condition, suggesting that receiving nutrition education is not advantageous to receiving a prefilled grocery shopping cart in increasing nutrition knowledge. Furthermore, nutrition outcomes (e.g. HEI scores, calories, and energy density) did not change throughout the course of the intervention in the Nutrition Education condition despite an increase in nutrition knowledge, suggesting that the increase in nutrition knowledge did not impact purchasing behavior.

Participants’ nutrition literacy (i.e., ability to read a nutrition label) remained unchanged from baseline to post-intervention in both the Nutrition Education and Default conditions. Participants in both conditions answered approximately 2 out of 6 questions correctly at baseline and at the end of the intervention, suggesting a need for interventions that demonstrate how to read a nutrition label in individuals with food insecurity. However, one of the benefits of utilizing a prefilled online default grocery shopping cart as an intervention approach is that participants are provided a healthy template and nutrition knowledge is not required to benefit from the intervention.

Additionally, objectively-measured weight (measured pre- and post-intervention) did not significantly change throughout the course of the study in both treatment conditions. In the present study, participants were able to receive their SNAP benefits, receive assistance at their local food pantry, and participate in our intervention so it is possible that the lack of weight
change is due to the excess food purchasing that inevitability occurred as a result of participating in this intervention. In future studies, researchers should utilize the prefilled online grocery shopping cart with the use of SNAP benefits to increase generalizability.

**Strengths**

Strengths of the present study include that participants selected and had their groceries delivered using a local retailer’s online grocery shopping website. Additionally, this study analyzed grocery purchases longitudinally including the examination of a baseline grocery shopping visit prior to randomization, whereas previous studies were only able to examine this intervention approach at one timepoint with no baseline data (Coffino & Hormes, 2018; Coffino et al., 2020). Furthermore, this study expanded upon previous studies by analyzing objectively-measured weight and nutrition literacy and knowledge pre- and post-intervention.

Additionally, NDSR was used to input the grocery purchases which is considered to be the premiere database for nutrition with over 18,000 foods registered in the system and a food group serving count system that allows researchers to estimate nutrients of food and drink products (“NDSR Software”, 2019) Furthermore, HEI scores were used to analyze the diet quality of grocery carts, which aligns with the dietary recommendations from the Dietary Guidelines for Americans.

**Limitations**

Although there are many strengths to this study, limitations should be noted. This study was adequately powered to detect between-group differences from baseline to the beginning of the treatment period, but was not fully powered during the active treatment period. It is possible that we were unable to detect significant effects during certain timepoints in the active treatment period due to our small sample size. Additionally, the groceries purchased online by participants
were purchased with study funds, so it is possible that participants would react differently to the prefilled online grocery shopping cart if they used their own money to purchase its content. For example, participant grocery purchases may not accurately reflect actual preferences – but rather “extras” that they wouldn’t otherwise be able to purchase/ eat. Furthermore, participants had access to the food pantry and use of their SNAP benefits (if they received benefits) in addition to the study funds so it is possible that participants did not experience weight loss because they were consuming excess calories. Future studies should test if the positive effects seen in the Default condition remain and weight decreases when participants use their own money to purchase groceries.

Additionally, if participants were recruited from the food pantry and verbalized with the research assistant that they considered themselves to have food insecurity, they met inclusion criteria for the present study. There were participants in the present study who endorsed high food security on the U.S. food security survey despite receiving assistance from a food pantry. In future studies, it may be useful to limit recruitment to people who endorse food insecurity on a validated measure and receive SNAP benefits since research has demonstrated a positive relationship between BMI and SNAP participation particularly in nonelderly women, who account for 28% of SNAP recipients (Ver Ploeg & Ralston, 2008). Additionally, there were no questions included in this study that assessed participant motivation for weight loss and eating healthy. Future studies should assess motivation for health as this may impact how much participants take advantage of using the prefilled default cart.

Furthermore, inclusion criteria required participants to live in a single person household, but a majority of SNAP recipients live with dependents in their households (Coleman-Jensen et al., 2019). Future studies should include participants with spouses and dependents. Other issues
that could affect generalizability include that we did not assess the income levels of participants and participants were recruited from one geographic location in the northeastern United States. Despite these limitations, the default approach via an online platform has a lot of potential implications for improving diet and diet-related health in individuals with food insecurity.

Implications

On April 18th, 2019 for the first time in history SNAP recipients were able to pay for groceries online (“Online Purchasing Pilot”, 2019). Specifically, three large retailers in New York are allowing EBT payments through their websites with option for delivery (dependent on the location of SNAP recipient). If the piloting program in New York is successful, more retailers in seven additional states are anticipated to take part in the pilot program. With the expansion of EBT card use online, individuals in food deserts may now be able to have access to healthier and cheaper groceries that are more often found in large supermarket chains such as the ones that are participating in the pilot program (e.g., Walmart, Amazon, ShopRite). Furthermore, interventions utilizing a prefilled grocery shopping cart can be implemented with more ease if EBT cards are able to be used for online grocery shopping. Based on the available data that demonstrates an association between SNAP participation and obesity (Gibson, 2003) it is important for researchers to implement feasible and sustainable interventions in this population. The default approach may be such an intervention that can be broadly implemented on an online platform with the use of EBT cards.

Current strategies to improve healthy eating in SNAP recipients include financial incentives, which although effective, will cost the government more money than using a default approach. Furthermore, research has demonstrated that financial incentives increase fruit and vegetable expenditures but the effects are modest and not sustainable if financial incentives are
no longer offered (Steele-Adjognon & Weatherspoon, 2017). Therefore, financial incentives may not be a sustainable intervention approach given the large amount of participants enrolled in SNAP. Other strategies suggested by policymakers to improve healthy eating include placing bans or restrictions on unhealthy food/drink items but this approach is controversial and may be perceived as paternalistic. Therefore, it seems like the default option is an intervention approach worth exploring further in individuals with food insecurity.

**Summary and Conclusions**

If obesity rates continue to rise at the expected rate, over half of the world’s adult population will have obesity by 2030 (Finkelstein et al., 2012). These rates may be of particular concern for individuals with food insecurity who are at elevated risk of obesity and historically have had insufficient resources to acquire nutritionally balanced meals. With the new pilot program testing the use of EBT cards online, online grocery shopping can potentially serve as a new platform to deliver interventions aimed at improving the diet quality of individuals with food insecurity. These online interventions can help overcome barriers often faced by this population such as transportation issues, disability or poor health, and time constraints. The present findings, coupled with the exponential growth of online shopping, can inform policy decisions with initiatives that aim to increase healthy eating, particularly in individuals with food insecurity.
References


intervention on sales of nutritious foods to youth and their families. *Journal of the Academy of Nutrition and Dietetics, 112*(6), 897-901.


### Table 1. Baseline Characteristics of Randomized Participants in the Nutrition Education and Default-option Intervention Groups

<table>
<thead>
<tr>
<th></th>
<th>Total Sample</th>
<th>Nutrition Education</th>
<th>Default</th>
<th>Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(n = 38)</td>
<td>(n = 19)</td>
<td>(n = 19)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>% (n) or M (SD)</td>
<td>% (n) or M (SD)</td>
<td>% (n) or M (SD)</td>
<td></td>
</tr>
<tr>
<td>Age (years)</td>
<td>47.53 (14.23)</td>
<td>48.05 (16.42)</td>
<td>47.00 (12.10)</td>
<td>t (36) = -.23, p = .82, d = .07</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>30.49 (6.46)</td>
<td>29.28 (5.78)</td>
<td>31.64 (7.00)</td>
<td>t (35) = 1.11, p = .27, d = .37</td>
</tr>
<tr>
<td>Sex (Male)</td>
<td>52.60% (n = 20)</td>
<td>52.60% (n = 10)</td>
<td>52.60% (n = 10)</td>
<td>χ² = .00, p = 1.00, φ = .00</td>
</tr>
<tr>
<td>Non-white</td>
<td>71.10% (n = 27)</td>
<td>73.70% (n = 14)</td>
<td>68.40% (n = 13)</td>
<td>χ² = .13, p = .72, φ = .06</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
<td>χ² = 2.23, p = .33, φ = .25</td>
</tr>
<tr>
<td>less than H.S.</td>
<td>13.90% (n = 5)</td>
<td>22.20% (n = 4)</td>
<td>5.60% (n = 1)</td>
<td></td>
</tr>
<tr>
<td>H.S. or GED</td>
<td>27.80% (n = 10)</td>
<td>27.80% (n = 5)</td>
<td>27.80% (n = 5)</td>
<td></td>
</tr>
<tr>
<td>at least some college</td>
<td>58.30% (n = 21)</td>
<td>50.00% (n = 9)</td>
<td>66.70% (n = 12)</td>
<td></td>
</tr>
<tr>
<td>USDA Food Security Survey</td>
<td></td>
<td></td>
<td></td>
<td>χ² = .71, p = .70, φ = .14</td>
</tr>
<tr>
<td>High/marginal food security</td>
<td>13.50% (n = 5)</td>
<td>11.10% (n = 2)</td>
<td>15.80% (n = 3)</td>
<td></td>
</tr>
<tr>
<td>Low food security</td>
<td>32.40% (n = 12)</td>
<td>38.90% (n = 7)</td>
<td>26.30% (n = 5)</td>
<td></td>
</tr>
<tr>
<td>Very low food security</td>
<td>54.10% (n = 20)</td>
<td>50.00% (n = 9)</td>
<td>57.90% (n = 11)</td>
<td></td>
</tr>
<tr>
<td>Social Desirability Scale</td>
<td>20.71 (5.37)</td>
<td>21.87 (5.10)</td>
<td>19.63 (5.56)</td>
<td>t (29) = -1.17, p = .25, d = .42</td>
</tr>
<tr>
<td>Binge Eating Scale</td>
<td>9.71 (7.84)</td>
<td>9.41 (8.75)</td>
<td>10.00 (7.12)</td>
<td>t (33) = .22, p = .83, d = .07</td>
</tr>
<tr>
<td>DEBQ: Emotional Eating</td>
<td>2.25 (1.11)</td>
<td>2.09 (.99)</td>
<td>2.40 (1.21)</td>
<td>t (32) = .82, p = .42, d = .28</td>
</tr>
<tr>
<td>DEBQ: External Eating</td>
<td>2.86 (.74)</td>
<td>2.72 (.74)</td>
<td>3.00 (.73)</td>
<td>t (32) = 1.12, p = .27, d = .38</td>
</tr>
<tr>
<td></td>
<td>Mean 1</td>
<td>Mean 2</td>
<td>Mean 3</td>
<td>t (df)</td>
</tr>
<tr>
<td>--------------------------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
</tr>
<tr>
<td>DEBQ: Restrained Eating</td>
<td>2.52 (.84)</td>
<td>2.51 (.72)</td>
<td>2.54 (.96)</td>
<td>t (33) = .11, p = .92, d = .04</td>
</tr>
<tr>
<td>Food Neophobia Scale</td>
<td>45.23 (11.53)</td>
<td>44.13 (11.48)</td>
<td>46.16 (11.81)</td>
<td>t (33) = .51, p = .61, d = .17</td>
</tr>
<tr>
<td>Newest Vital Sign</td>
<td>2.13 (2.16)</td>
<td>2.00 (2.12)</td>
<td>2.26 (2.26)</td>
<td>t (36) = .37, p = .71, d = .12</td>
</tr>
<tr>
<td>Nutrition Knowledge</td>
<td>3.27 (1.33)</td>
<td>3.28 (1.49)</td>
<td>3.26 (1.19)</td>
<td>t (35) = -.03, p = .97, d = .01</td>
</tr>
</tbody>
</table>
Table 2. Nutrition Education Brochure Given to Participants in the Nutrition Education Condition

<table>
<thead>
<tr>
<th>Timepoints</th>
<th>Brochure Titles</th>
<th>Brochure Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Timepoint 1</strong></td>
<td>1. 10 tips to a great plate</td>
<td>1. Make half your grains whole grains.</td>
</tr>
<tr>
<td></td>
<td>2. Small changes make a large difference</td>
<td>2. Instead of choosing canned fruit packed in syrup choose fresh or frozen fruit.</td>
</tr>
<tr>
<td></td>
<td>3. Tips of choosing lean proteins</td>
<td>3. Bake, broil, or microwave lean beef, pork, chicken, and turkey.</td>
</tr>
<tr>
<td><strong>Timepoint 2</strong></td>
<td>1. Tips for healthier choices</td>
<td>1. If you usually buy whole milk try fat-free (skim), low-fat (1%) milk.</td>
</tr>
<tr>
<td></td>
<td>2. 10 tips for healthy meals</td>
<td>2. Make half your plate veggies and fruits.</td>
</tr>
<tr>
<td></td>
<td>3. 10 tips to help you eat whole grains</td>
<td>3. Make half your grains whole grains.</td>
</tr>
<tr>
<td><strong>Timepoint 3</strong></td>
<td>1. 10 tips to help you eat more vegetables</td>
<td>1. Choose vegetables rich in color.</td>
</tr>
<tr>
<td></td>
<td>2. 10 tips to help you eat more fruits</td>
<td>2. Include fruit at breakfast.</td>
</tr>
<tr>
<td></td>
<td>3. Watch your fats, sugars, and sodium</td>
<td>3. Cook at home so you know what goes into your food.</td>
</tr>
<tr>
<td><strong>Timepoint 4</strong></td>
<td>1. Go, slow, and whoa foods</td>
<td>1. Go: fat free milk; Slow: 2% milk; Woah: whole milk</td>
</tr>
<tr>
<td></td>
<td>2. Go, slow, and whoa foods continued</td>
<td>2. Go: water; Slow: sports drinks; Woah: regular soda</td>
</tr>
</tbody>
</table>
### Table 3. Slope and Slope Differences by Treatment Condition for Primary Outcome Variables

<table>
<thead>
<tr>
<th>Measure</th>
<th>Treatment Condition</th>
<th>T0 to T1 Slope (SE) [95% CI]</th>
<th>Nutrition Education vs. Default</th>
<th>T1 to T4 Slope (SE) [95% CI]</th>
<th>Nutrition Education vs. Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>Healthy Eating Index</td>
<td>Nutrition Education</td>
<td>2.52 (3.37) [-4.15, 9.18]</td>
<td>( \delta = 14.1^{**} ) ( t (135) = 2.92 ) ( p = 0.004 )</td>
<td>-1.12 (1.08) [-3.35, 0.93]</td>
<td>( \delta = 0.72 ) ( t (135) = 0.47 ) ( p = 0.63 )</td>
</tr>
<tr>
<td></td>
<td>Default</td>
<td>16.59 (3.44)^** [9.79, 23.39]</td>
<td></td>
<td>1.93 (1.10) [-4.10, 0.24]</td>
<td></td>
</tr>
<tr>
<td>Calories (kcal)</td>
<td>Nutrition Education</td>
<td>4.003 (2.346) [-648, 8,654]</td>
<td>( \delta = -10.306^{**} ) ( t (134) = -2.90 ) ( p = 0.004 )</td>
<td>-574 (423) [-1410, 263]</td>
<td>( \delta = 2030^{**} ) ( t (134) = 3.11 ) ( p = 0.002 )</td>
</tr>
<tr>
<td></td>
<td>Default</td>
<td>-6,303 (2,352)^** [-10,942, -1,663]</td>
<td></td>
<td>1456 (433)^** [600, 2311]</td>
<td></td>
</tr>
<tr>
<td>Energy Density (kcal/g)</td>
<td>Nutrition Education</td>
<td>0.16 (0.17) [-0.17, 0.48]</td>
<td>( \delta = -0.53^{*} ) ( t (135) = -2.26 ) ( p = 0.02 )</td>
<td>-0.03 (0.05) [-0.14, 0.07]</td>
<td>( \delta = 0.18^{*} ) ( t (135) = 2.38 ) ( p = 0.02 )</td>
</tr>
<tr>
<td></td>
<td>Default</td>
<td>-0.37 (0.17)^** [-0.70, -0.45]</td>
<td></td>
<td>0.14 (0.05)^* [0.04, 0.25]</td>
<td></td>
</tr>
</tbody>
</table>

Note: * \( p <.05 \), ** \( p <.01 \), *** \( p <.001 \); \( \delta \) = difference in slopes by treatment condition; Slopes were calculated as part of the piecewise LME models using least-squares trends. 95% confidence intervals that do not include 0 indicate a significantly positive or negative trend.
## Table 4. Means, Standard Errors, and Effect Sizes by Treatment Condition at Each Timepoint

<table>
<thead>
<tr>
<th>Measure</th>
<th>Treatment Condition</th>
<th>Pre-Treatment Period</th>
<th>Active Treatment Period</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>T0: Baseline</td>
<td>T1: Week 1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>M (SE)</td>
<td>M (SE) Effect Size (d)</td>
</tr>
<tr>
<td>Healthy Eating Index</td>
<td>Nutrition Education</td>
<td>53.71 (3.45) .24</td>
<td>56.23 (3.26) 1.13*</td>
</tr>
<tr>
<td></td>
<td>Default</td>
<td>51.21 (3.39)</td>
<td>67.80 (3.30)</td>
</tr>
<tr>
<td>Calories (kcal)</td>
<td>Nutrition Education</td>
<td>13,123 (2,265) .36</td>
<td>17,126 (1,314) 1.39**</td>
</tr>
<tr>
<td></td>
<td>Default</td>
<td>17,144 (2,218)</td>
<td>10,841 (1,352)</td>
</tr>
<tr>
<td>Energy Density (kcal/g)</td>
<td>Nutrition Education</td>
<td>1.45 (0.15) .12</td>
<td>1.61 (0.10) 1.32**</td>
</tr>
<tr>
<td></td>
<td>Default</td>
<td>1.50 (0.15)</td>
<td>1.13 (0.11)</td>
</tr>
</tbody>
</table>

Note: *p < .05, **p < .01; ***p < .001; Between-condition differences at each timepoint were calculated from the piecewise LME model using least-squares means. Effect sizes were calculated using the following formula: (difference between means)/(standard deviation of the residuals for the full LME model) (Hedges, 2007).
Figure 1. Participant Flow Diagram for the Nutrition Education and Default Condition

Excluded ($n = 1$)
- Could not complete length of experimental task

Screened ($n = 46$)
- Not fluent in English ($n = 2$)
- Lost to follow up ($n = 2$)
- Mental health ($n = 1$)
- Homeless ($n = 1$)

Enrolled ($n = 39$)
- Not interested ($n = 1$)
- Dropped out after baseline ($n$)

Randomized ($n = 38$)
- Dropped out after T3 ($n = 1$)

Allocation

Allocated to education ($n = 19$)
- Completed experimental task ($n = 18$)

Allocated to default ($n = 19$)
- Completed experimental task ($n = 17$)
Figure 2. Healthy Eating Index from Pre-Treatment to Post-Treatment
Figure 3. Total Calories from Pre-Treatment to Post-Treatment
Figure 4. Energy Density from Pre-Treatment to Post-Treatment
Appendix 1. Sample of Nutrition Education Brochures

10 tips
Nutrition Education Series

choose MyPlate
10 tips to a great plate

1 balance calories
Find out how many calories YOU need for a day as a first step in managing your weight. Go to www.ChooseMyPlate.gov to find your calorie level. Being physically active also helps you balance calories.

2 enjoy your food, but eat less
Take the time to fully enjoy your food as you eat it. Eating too fast or when your attention is elsewhere may lead to eating too many calories. Pay attention to hunger and fullness cues before, during, and after meals. Use them to recognize when to eat and when you’ve had enough.

3 avoid oversized portions
Use a smaller plate, bowl, and glass. Portion out foods before you eat. When eating out, choose a smaller size option, share a dish, or take home part of your meal.

4 foods to eat more often
Eat more vegetables, fruits, whole grains, and fat-free or 1% milk and dairy products. These foods have the nutrients you need for health—including potassium, calcium, vitamin D, and fiber. Make them the basis for meals and snacks.

5 make half your plate fruits and vegetables
Choose red, orange, and dark-green vegetables like tomatoes, sweet potatoes, and broccoli, along with other vegetables for your meals. Add fruit to meals as part of main or side dishes or as dessert.

6 switch to fat-free or low-fat (1%) milk
They have the same amount of calcium and other essential nutrients as whole milk, but fewer calories and less saturated fat.

7 make half your grains whole grains
To eat more whole grains, substitute a whole-grain product for a refined product—such as eating whole-wheat bread instead of white bread or brown rice instead of white rice.

8 foods to eat less often
Cut back on foods high in solid fats, added sugars, and salt. They include cakes, cookies, ice cream, candies, sweetened drinks, pizza, and fatty meats like ribs, sausages, bacon, and hot dogs. Use these foods as occasional treats, not everyday foods.

9 compare sodium in foods
Use the Nutrition Facts label to choose lower sodium versions of foods like soup, bread, and frozen meals. Select canned foods labeled “low sodium,” “reduced sodium,” or “no salt added.”

10 drink water instead of sugary drinks
Cut calories by drinking water or unsweetened beverages. Soda, energy drinks, and sports drinks are a major source of added sugar, and calories, in American diets.

Go to www.ChooseMyPlate.gov for more information.
10 tips
Nutrition Education Series

make half your grains whole grains

10 tips to help you eat whole grains

Any food made from wheat, rice, oats, cornmeal, barley, or another cereal grain is a grain product. Bread, pasta, oatmeal, breakfast cereals, tortillas, and grits are examples. Grains are divided into two subgroups, whole grains and refined grains. Whole grains contain the entire grain kernel—the bran, germ, and endosperm. People who eat whole grains as part of a healthy diet have a reduced risk of some chronic diseases.

1. make simple switches
   To make half your grains whole grains, substitute a whole-grain product for a refined-grain product. For example, eat 100% whole-wheat bread or bagels instead of white bread or bagels, or brown rice instead of white rice.

2. whole grains can be healthy snacks
   Popcorn, a whole grain, can be a healthy snack. Make it with little or no added salt or butter.
   Also, try 100% whole-wheat or rye crackers.

3. save some time
   Cook extra brown rice or whole-wheat pasta when you have time. Refrigerate half to heat and serve later in the week as a quick side dish.

4. mix it up with whole grains
   Use whole grains in mixed dishes, such as barley in vegetable soups or stews and bulgur wheat in casseroles or stir-fries. Try a quinoa salad or pilaf.

5. try whole-wheat versions
   For a change, try brown rice or whole-wheat pasta. Try brown rice stuffing in baked green peppers or tomatoes, and whole-wheat macaroni in macaroni and cheese.

6. bake up some whole-grain goodness
   Experiment by substituting buckwheat, millet, or oat flour for up to half of the flour in your favorite pancake or waffle recipes. To limit saturated fat and added sugars, top with fruit instead of butter and syrup.

7. be a good role model for children
   Set a good example for children by serving and eating whole grains every day with meals or as snacks.

8. check the label for fiber
   Use the Nutrition Facts label to check the fiber content of whole-grain foods. Good sources of fiber contain 10% to 18% of the Daily Value; excellent sources contain 20% or more.

9. know what to look for on the ingredients list
   Read the ingredients list and choose products that name a whole-grain ingredient first on the list. Look for "whole wheat," "brown rice," "bulgur," "buckwheat," "oatmeal," "whole grain cornmeal," "whole oats," or "whole rye."

10. be a smart shopper
    The color of a food is not an indication that it is a whole-grain food. Foods labeled as "multi-grain," "stone-ground," "100% wheat," "cracked wheat," "seven-grain," or "bran" are usually not 100% whole-grain products, and may not contain any whole grain.

Center for Nutrition Policy and Promotion
USDA is an equal opportunity provider and employer.

Go to www.ChooseMyPlate.gov for more information.

DG Tipsheet No. 4
Revised January 2016
Eating fruit provides health benefits. People who eat more vegetables and fruits as part of an overall healthy diet are likely to have a reduced risk of some chronic diseases. Fruits provide nutrients vital for health, such as potassium, dietary fiber, vitamin C, and folate (folic acid). Most fruits are naturally low in fat, sodium, and calories. None have cholesterol. Any fruit or 100% fruit juice counts as a part of the Fruit Group. Fruits may be fresh, canned, frozen, or dried, and may be whole, cut-up, or pureed.

1. Keep visible reminders
   Keep a bowl of whole fruit on the table, counter, or in the refrigerator.

2. Think about taste
   Buy fresh fruits in season when they may be less expensive and at their peak flavor. Add fruits to sweeten a recipe.

3. Think about variety
   Buy fruits that are dried, frozen, and canned (in water or 100% juice) as well as fresh, so that you always have a supply on hand.

4. Don’t forget the fiber
   Make most of your choices whole or cut-up fruit, rather than juice, for the benefits that dietary fiber provides.

5. Be a good role model
   Set a good example for children by eating fruit every day with meals or as snacks.

6. Include fruit at breakfast
   At breakfast, top your cereal with bananas, peaches, or strawberries; add blueberries to pancakes; drink 100% orange or grapefruit juice. Or, try a fruit mixed with fat-free or low-fat yogurt.

7. Try fruit at lunch
   At lunch, pack a tangerine, banana, or grapes to eat, or choose fruits from a salad bar. Individual containers of fruits like peaches or applesauce are easy and convenient.

8. Experiment with fruit at dinner, too
   At dinner, add crushed pineapple to coleslaw, or include orange sections, dried cranberries, or grapes in a tossed salad.

9. Snack on fruits
   Dried fruits make great snacks. They are easy to carry and store well.

10. Keep fruits safe
    Rinse fruits before preparing or eating them. Under clean, running water, rub fruits briskly to remove dirt and surface microorganisms. After rinsing, dry with a clean towel.

Go to www.ChooseMyPlate.gov for more information.
GO, SLOW, and WHOA Foods
Use this chart as a guide to help you and your family make smart food choices. Post it on your refrigerator at home, or take it with you to the store when you shop.

**GO foods**—Eat almost anytime.

**SLOW foods**—Eat sometimes or less often.

**WHOA foods**—Eat only once in a while or for special occasions.

<table>
<thead>
<tr>
<th>Food Group</th>
<th>GO (Almost anytime foods [Nutrient-dense foods])</th>
<th>SLOW (Sometimes foods [Moderate nutrients/calories])</th>
<th>WHOA (Once in a while foods [Calorie dense foods])</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vegetables</td>
<td>Almost all fresh, frozen, and canned vegetables without added fat and sauces</td>
<td>All vegetables with added fat and sauces; oven-baked French fries; avocado</td>
<td>Fried potatoes, like French fries or hash browns; other deep-fried vegetables</td>
</tr>
<tr>
<td>Fruits</td>
<td>All fresh, frozen, canned in juice</td>
<td>100% fruit juice; fruits canned in light syrup; dried fruits</td>
<td>Fruits canned in heavy syrup</td>
</tr>
<tr>
<td>Breads and Cereals</td>
<td>Whole-grain breads, including pita bread; tortillas and whole-grain pasta; brown rice; hot and cold unsweetened whole-grain breakfast cereals</td>
<td>White refined flour bread, rice, and pasta; French toast; taco shells; cornbread; biscuits; granola; waffles and pancakes</td>
<td>Croissants; muffins; doughnuts; sweet rolls; crackers made with trans fats; calorically sweetened breakfast cereals</td>
</tr>
<tr>
<td>Milk and Milk Products</td>
<td>Fat-free or 1% low-fat milk; fat-free or low-fat yogurt; part skim, reduced-fat, and fat-free cheese; low-fat or fat-free cottage cheese</td>
<td>2% low-fat milk; processed cheese spread</td>
<td>Whole milk; full-fat American, cheddar, Colby, Swiss, or cream cheese; whole-milk yogurt</td>
</tr>
<tr>
<td>Meats, Poultry, Fish, Eggs, Beans, and Nuts</td>
<td>Trimmed beef and pork; extra-lean ground beef; chicken and turkey without skin; tuna canned in water; baked, broiled, steamed, or grilled fish and shellfish; beans, split peas, lentils, tofu; egg whites and egg substitute</td>
<td>Lean ground beef; broiled hamburgers; ham, Canadian bacon; chicken and turkey with skin; low-fat hoi dogs; tuna canned in oil; peanut butter; nuts; whole eggs cooked without added fat</td>
<td>Untrimmed beef and pork; regular ground beef; fried hamburgers; ribs; bacon; fried chicken, chicken nuggets; hot dogs, lunch meats, pepperoni, sausage; fried fish and shellfish; whole eggs cooked with fat</td>
</tr>
<tr>
<td>Sweets and Snacks*</td>
<td>Ice milk bars; frozen fruit juice bars; low-fat or fat-free frozen yogurt and ice-cream; fig bars, ginger snaps, baked chips; low-fat microwave popcorn, pretzels</td>
<td>Cookies and cakes; pies; cheesecake; ice cream; chocolate; candy; chips; buttered microwave popcorn</td>
<td></td>
</tr>
</tbody>
</table>

* Though some of the foods in this row are lower in fat and calories, all sweets and snacks need to be limited, in order to stay within one’s daily calorie needs.
Appendix 2. *Example of the Prefilled Grocery Shopping Cart Example*

<table>
<thead>
<tr>
<th>Food Item</th>
<th>Quantity</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chicken Breast</td>
<td>2.25 pounds</td>
<td>$3.80</td>
</tr>
<tr>
<td>Red Grapefruit</td>
<td>2 grapefruits</td>
<td>$2.98</td>
</tr>
<tr>
<td>Sweet Potato</td>
<td>.89 pounds</td>
<td>$1.12</td>
</tr>
<tr>
<td>Spinach</td>
<td>8 ounces</td>
<td>$2.00</td>
</tr>
<tr>
<td>Cucumber</td>
<td>1 cucumber</td>
<td>$0.79</td>
</tr>
<tr>
<td>French Green Beans</td>
<td>.75 pounds</td>
<td>$1.87</td>
</tr>
<tr>
<td>Brussel Sprouts</td>
<td>1 pound</td>
<td>$3.99</td>
</tr>
<tr>
<td>Broccoli Florets</td>
<td>32 ounces</td>
<td>$3.58</td>
</tr>
<tr>
<td>Baby Carrots</td>
<td>12 ounces</td>
<td>$1.99</td>
</tr>
<tr>
<td>Blackberries</td>
<td>6 ounces</td>
<td>$3.49</td>
</tr>
<tr>
<td>Strawberries</td>
<td>16 ounces</td>
<td>$3.50</td>
</tr>
<tr>
<td>Pears</td>
<td>.78 pounds</td>
<td>$1.55</td>
</tr>
<tr>
<td>Creamy Peanut Butter</td>
<td>16.3 ounces</td>
<td>$1.99</td>
</tr>
<tr>
<td>Goya Black Beans</td>
<td>10.5 ounces</td>
<td>$0.89</td>
</tr>
<tr>
<td>1% Low Fat Milk</td>
<td>1 quart</td>
<td>$1.49</td>
</tr>
<tr>
<td>Light Blueberry Yogurt</td>
<td>96 ounces</td>
<td>$1.79</td>
</tr>
<tr>
<td>No Pulp Orange Juice</td>
<td>64 fluid ounces</td>
<td>$2.49</td>
</tr>
<tr>
<td>Romaine Lettuce</td>
<td>1 lettuce head</td>
<td>$1.99</td>
</tr>
<tr>
<td>Mcintosh Apple</td>
<td>.80 pounds</td>
<td>$1.59</td>
</tr>
<tr>
<td>Whole Wheat Wraps</td>
<td>10 ounces</td>
<td>$1.99</td>
</tr>
<tr>
<td>Swedish Fish</td>
<td>3.1 ounces</td>
<td>$1.29</td>
</tr>
</tbody>
</table>