EFFECTS OF SPECIAL SUPPLEMENTAL NUTRITION PROGRAM FOR WOMEN, INFANTS, AND CHILDREN (WIC) PARTICIPATION ON HOUSEHOLD FOOD AVAILABILITY

by

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ABSTRACT

Public health messages have focused on the health benefits of consuming more fruits and vegetables. The Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) is a needs-based program that offers nutrition education and a food supplement or voucher.

This study assesses the effect that WIC participation has on availability of healthy food. Additionally, this study accounts for potential nonrandom selection bias into WIC by employing techniques that address self-selection bias. The data were drawn from the National Health and Nutrition Examination Survey (NHANES) 2007-10 Consumer Behavior Survey.

Results from switching regression equations reveal that WIC participation is negatively associated with fruit and dark leafy green vegetable availability at home. More research needs to be conducted on the effects of WIC participation on household food availability.

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INTRODUCTION

In recent years, public health messages have focused on the health benefits of consuming more fruits and vegetables. Research has linked food availability with increased fruit and vegetable consumption (Cullen et al., 2003; Ding et al., 2012; Hanson, Neumark-Sztainer, Eisenberg, Story, & Wall, 2004; Hearn et al., 1998; Kratt, Reynolds, & Shewchuk, 2000). Food availability, specifically the availability of fruits and vegetables, has been linked with income. Households with higher incomes typically have greater availability of fruits and vegetables (Kratt et al., 2000). Research has also shown that public programs can affect the food availability of program participants (Andreyeva, Luedicke, Henderson, & Tripp, 2012). The purpose of this study is to examine the effects of WIC participation on household food availability.

The Special Supplemental Nutrition Program for Women Infants and Children (WIC) is a needs-based program for low-income, pregnant, or nursing women and children less than 5 years of age. Participants must have incomes less than 185% of the federal poverty threshold. The program offers nutrition education and a food supplement, or voucher, to help participants make healthier food choices and to increase access to healthy food. In 2012, WIC assisted an average of 8.9 million individuals per month, and covered nearly 50% of all women who gave birth in the United States (Martinez-Schiferl, Zedlewski, & Giannarelli, 2013; Oliveira, 2013). Current research on the WIC program focuses on fruit and vegetable consumption or specific nutrients in participants' diets, not on WIC's effect on household food availability (Silvie et al., 2012). Household food availability is an important measure that can be used as an explanation for consumption patterns in participants' homes. Because WIC reaches so many individuals, it has the potential to have a large impact on household food availability. This study investigated potential effects of WIC participation on household food availability, and thus fills an existing gap in the literature relating to WIC participation on potential food-related outcomes.

LITERATURE REVIEW

WIC is designed to improve the diets of pregnant and nursing women, infants, and children ages 1-4 years. The WIC food supplements, in the form of vouchers, are designed to increase participants' access to food higher in minerals and vitamins deemed essential for healthy diets (Martinez-Schiferl et al., 2013). In a study on WIC and nutritional risk, M. Bitler et al. (2005) found that WIC participants had higher food insecurity and reported poorer diet quality compared to eligible non-WIC participants. They gathered their sample from the 1996 panel of the Survey of Income and Program Participation (SIPP) and used income measures to determine a household's program eligibility. The study did not have a pre- or postparticipation measure, but rather was a snapshot of the current status of WIC participants (M. Bitler, Gundersen, & Marquis, 2005). This study indicated that the WIC program is reaching its target population of nutritionally at-risk women and children. It is not clear if the services WIC provide are improving the diet quality through WIC health education and food vouchers.

WIC and Nonrandom Selection Bias

Previous studies of the effects of WIC participation on individual well-being involved a risk of bias resulting from unmeasured selection factors. Not all eligible women claim benefits, and if selection into WIC involves the neediest or least motivated women, studies comparing household outcomes among WIC participants and nonparticipants that fail to adjust for differences in "need" may underestimate the effects of the program. In contrast, if WIC participants are more highly motivated than nonparticipants, then studies that fail to adjust for motivation may overestimate the program's effects. Because the WIC program is locally administered, factors governing selection into the program are also likely to change over time and place.

Current research on WIC has attempted to correct for the issue of self-selection. Given that random assignment to WIC "treatment" groups is neither feasible nor ethical, researchers must employ statistical models that attempt to correct for self-selection. Without correcting for self-selection, results may be an artifact of the self-selection and not caused by the program itself. The issue of self-selection is a major weakness in many WIC evaluation studies (Silvie et al., 2012).

WIC and Health Education

One of the mechanisms by which WIC participation could impact women is via the health education component of the program. Ritchie et al. (2010) evaluated a new WIC education program designed to inform participants on the health benefits of eating a diversity of fruits and vegetables, whole grain bread, and low-fat milk. As a result of the education program, WIC participants reported eating more fruits and vegetables and drinking low-fat milk. The researchers discovered that participants were able to recall the education messages. In contrast to the reports from participants, food frequency questions, which measure the total amount of food consumed, did not detect a statistically significant difference in fruit and vegetables consumed. The authors concluded that participants may have reported more consumption of fruits and vegetables, when in reality there was not one because of the social desirability effect (Ritchie, Whaley, Spector, Gomez, & Crawford, 2010).

Wojcicki and Heyman (2011) studied WIC participation's effects on food label use. In their study, they used the 2005-2006 NHANES data to gather a cross-sectional, nationally representative sample. They identified two groups using the income threshold of 185% of the federal poverty line. Their results indicated that nonparticipants used food labels more often than WIC participants. This is concerning, especially considering the educational component of WIC, because using nutrition labels is ideally supposed to be taught in the education classes. A weakness of their study design is that they did not seek to correct their data for the selection bias of WIC participation; therefore, their results should be interpreted with caution (Wojcicki & Heyman, 2011). This suggests the importance of addressing selection bias in WIC research

because results may be caused by self-selection into the program and not the program itself. It is entirely possible that participants in WIC are different than those who do not participate, so program effects become difficult to determine.

In a study conducted on psychosocial factors, like self-efficacy and perceived barriers in a WIC education intervention, Langenberg et al. (2000) found that their intervention improved self-efficacy and other psychosocial factors in participants and that the participants increased consumption of fruits and vegetables. Their study utilized a randomized field experiment control trial and they collected their sample from 16 WIC sites in Maryland. The sites were randomized into either a control or intervention group. Researchers approached women who came to pick up their vouchers and invited them to participate. Equal numbers of women were recruited for the control and experimental groups. They established a baseline measure and followed up 6 months later using a 7-item Food Frequency Questionnaire. They found that participants in the treatment group reported a statistically significant increase in their consumption of fruits and vegetables relative to the control group. They also found an improvement in psychosocial scores, such as self-efficacy (Langenberg et al., 2000). WIC nutrition education is an important program component. The nutrition education likely works in combination with the vouchers to produce an effect on participant behaviors. This study recognizes its importance as a program factor.

WIC and Vouchers

A key component of the WIC program is the food vouchers that are available to participants. Vouchers are a direct food subsidy that can be redeemed at WIC approved stores. In 2009, a major change occurred in the products redeemable by the vouchers. Prior to 2009, WIC participants could redeem vouchers for carrots, tuna, milk, infant cereal, fruit juice, peanut butter, cheese, regular cereal, eggs, and dry beans. Vouchers could also be issued to purchase infant formula. WIC state agencies are responsible to verify and approve these products within federal guidelines. WIC agencies also have the authority to alter voucher access to specific types of products. In October 2009, state agencies were required to issue vouchers that conformed to the 2005 guidelines for Healthy Americans (Cole, Jacobson, Nichols-Barrer, & Fox, 2011). The

changes included offering some fresh, canned, or frozen fruits and vegetables, changing the type of milk available for redemption from whole milk to low-fat or fat-free, and allowing for the purchase of whole grain bread and whole wheat tortillas.

The largest change in vouchers was the addition of fruits and vegetables. Before the change in policy, Herman et al. (2008) researched the effect of adding a WIC voucher for fruits and vegetables. They took their sample from three suburban Los Angeles WIC offices, and had approximately 600 participants. Participants from two locations served as the intervention group, with the third acting as the control. They chose a higher value for their fruit and vegetable vouchers ($40) than would be possible with the WIC program. Their vouchers could be redeemed at either a farmers market or super market. They found that participants nearly used all their vouchers to purchase fresh fruits and vegetables. The authors also found that vouchers used at farmers markets were redeemed for a larger range of fruits and vegetables than at the supermarket. The authors conclude that WIC participants would support the addition of a voucher to purchase fruits and vegetables (Herman, Harrison, & Jenks, 2006).

In a subsequent study, Herman, Harrison, Afifi, and Jenks (2008) measured the consumption of fruits and vegetables of WIC participants. They found overall a statistically significant difference between the intervention groups and control group in fruit and vegetable consumption immediately following the study. Most of the difference is found with the consumption of vegetables, and participants who shopped at farmers markets maintained higher levels of fruit and vegetable consumption. Ultimately, the authors conclude that the changes proposed to the WIC program will be consistent with participant preferences for fruit and vegetables (Herman et al., 2008). Both of the studies by Herman et al. (2006, 2008) are limited in generalizability because they used data from just one city. The Herman studies, however, do demonstrate that there is an association with subsidizing specific foods and food purchasing behaviors.

Several studies have investigated the change in vouchers after October 2009. These studies do not consider changes in specific behaviors of WIC participants because of the voucher changes, but rather seek to determine the effects of the voucher change on local grocery stores.

Hillier et al. used a pre/posttest design to evaluate the changes in stores in two contiguous zip codes in Philadelphia. They utilized the Nutrition Environment Measure Survey for Stores (NEMS-S), which is an assessment on the quality and availability of fruits, vegetables, milk, and other healthy items. They found that after the 2009 WIC voucher change, all stores in the study area had increased the availability and quality of fruits and vegetables, whole grains, and low-fat milk (Hillier et al., 2012). Havens et al. (2012) also had similar results in a study they did in Hartford, Connecticut. Using trained researchers, they collected store inventories from 45 selected corner stores. They found that WIC certified stores demonstrated significant changes in stocking of fruits, vegetables, and whole grains. In contrast to Hillier et al., they did not find that non-WIC stores experienced the same increase (Havens, Martin, Yan, Dauser-Forrest, & Ferris, 2012). Zenk et al. (2012) performed a study in Illinois that investigated the change that vouchers had on stores in African American communities. Using field observers, they found a statistically significant change in the availability of fruits and vegetables in stores (Zenk et al., 2012). Andreyeva et al. (2012) analyzed all convenience stores in five towns in Connecticut. Using a rating scale and trained observers, they found that all stores had an increase in healthy food items. Though they found an increase in fruit and vegetable availability, the largest increase was found in the availability of whole grains. These articles indicate that the availability of foods in stores is affected by the WIC voucher program.

Black et al. (2009) investigated the perception of WIC participants on the changes in WIC vouchers. The 2007 study utilized a convenience sample that was obtained from five diverse counties in Maryland. Participants were asked by interviewers to participate at WIC clinics. One hundred eighty-seven individuals completed the interview and 36 participated in a focus group. The sample was ethnically and racially diverse. The researchers found that cost and taste were the determining factors in fruit and vegetable selection. They also found differences by race in consumption, with African American women reporting less fresh vegetable consumption. Participants reported that they would utilize vouchers for fruits and vegetables, ultimately increasing their consumption of fruit and vegetables. Women also reported they would increase their consumption of whole grains, because WIC would provide them and they did not have to

pay for them. Many women reported a reluctance to change to low-fat milk and the authors noted a distinct racial difference, with more African American women and their children consuming whole milk than either Whites or Hispanics. The authors reported that with the changes in the WIC program, participants' consumption patterns should change, especially as they related to fruits and vegetables. The authors acknowledge that their study does not benefit from a random sample and some of their measurements on current consumption could suffer from recall bias (Black et al., 2009).

Evaluating the changes in the vouchers after 2009, Whaley et al. (2012) found that fruit and vegetable consumption did not increase in a statistically significant way. They used a pre/posttest design with a random sample of WIC participants in California. A total of 9,000 participants were selected in July 2009 before the change. The authors found that after the change in vouchers, participants reported a 51% increase in whole grain food consumption, and a 60-63% reduction in the consumption of whole milk. Both results were statistically significant. Respondents indicated a statistically significant change in their intake of vegetables but not fruit. The fruit and vegetable frequency survey, in contrast, revealed that the frequency of vegetables consumed did not differ significantly. Participants reported an increase but the researchers did not find one through the fruit and vegetable frequency survey. The authors indicate that overall, the vouchers did have an impact on the consumption of food, but their results may not be generalizable to the nation as a whole. Also, the authors note that the change in format happened uniformly in California and a randomized control trial was not possible (Whaley, Ritchie, Spector, & Gomez, 2012).

The voucher portion of the WIC program has a demonstrated effect on behavioral outcomes for participants. Vouchers increase purchasing ability of participants for specific goods. This increase in purchasing ability changes the products purchased. The products purchased likely reflect the items made available by the vouchers. This suggests that food availability in the home is affected by vouchers.

Household Food Availability

In a study on food preference formation, Birch (1999) indicated that the food environment in the home is important to developing children's food preferences. An important part of a child's food preference development is their interaction with their food environment. Birch also explained that the home food environment, or availability, reflects an adult's food preferences (Birch, 1999).

Kratt et al. (2000) investigated whether fruit and vegetable availability acted as a factor for fruit and vegetable intake. They designed a multigroup structural equation model to make comparisons between different levels of availability. Their results indicated that households with higher incomes report greater levels of fruit and vegetable availability. Fruit and vegetable availability was also lower in African American households. They also discovered that in households with higher fruit and vegetable availability, both parents and children reported higher levels of consumption, and had more psychosocial supports reinforcing their consumption. Overall, availability by itself was a statistically significant factor in predicting consumption (Kratt et al., 2000).

Ding et al. (2012) designed a study to assess the effects of community food availability on fruit and vegetable consumption, as well as household availability on fruit and vegetable consumption. They used different methods to determine the overall impact of availability, the level of healthful foods, the level of unhealthful foods, the ratio of healthful to unhealthful foods, and the availability of fruits and vegetables. Their findings demonstrated that the availability of fruits and vegetables and the ratio of healthful to unhealthful food produced the strongest associations. They did not find any statistically significant associations with community food environment and home food environment or availability (Ding et al., 2012).

Researching into the effect of availability and accessibility on youth with a high preference and a low preference for fruit and vegetables, Cullen et al. (2003) found that availability was associated with consumption for both preference groups. They used two collection methods: (1) trained observers who worked with children at school, and (2) parent phone interviews. They found that both the child and parents reports of availability and accessibility had a statistically significant association with child consumption (Cullen et al., 2003).

This study is important for WIC because it demonstrates that parental report of food availability is associated with consumption, meaning that this study can conclude that the report of WIC participants' food availability is associated with greater food consumption

In research done on the importance of fruit and vegetable accessibility and availability, Hearn et al. (1998) found that availability at home and school produced higher consumption rates in children. The sample was taken from multiple schools in a southeastern urban area of the United States that they do not name. They used parental reports for availability and accessibility of fruits and vegetables in the home and child report for the consumption of fruits and vegetables. They found a statistically significant association between consumption and availability of fruits and vegetables. The authors also give a logical comment that if the food is not available, it cannot be consumed. The authors also give a caveat that though availability is associated with consumption, the association is modest and accounts for approximately 11% of the variation in consumption, and that food preferences may account for the rest of the variation (Hearn et al., 1998). The children here are too old for WIC participation, but it shows that parental reports of food availability are related to consumption. This finding is likely true for all age groups of children, especially young children, because they do not have the ability to purchase their own food and will consume the food their parents purchase.

Andreyeva et al. (2012) investigated the beverage choices of SNAP and WIC participants using grocery store scanner data gathered from swiped loyalty cards. The unique way the data were collected allowed them to stratify the sample to persons using WIC vouchers only, those that used SNAP only, and those that used SNAP and WIC combinations. They concluded that WIC participants purchased slightly higher amounts of sugary sweetened beverages and that those that participated in the SNAP program consumed far greater amounts of sugary sweetened beverages than the national average. The authors concluded that this result was worrisome, because WIC participants have young children at home, which increases the likelihood that their children will consume sugary sweetened beverages and develop preferences for them (Andreyeva et al., 2012). In light of the food availability research, the access and availability of sugary substances in the home will definitely have an impact on the consumption of sugary

sweetened beverages by children. This study measured sugary sweetened beverages in WIC participant's homes.

Food availability at home is found to differ by income, race, ethnicity, and gender. The food availability is an important measure because lower food availability, especially the availability of fruit and vegetables, in the home is reported to be a significant barrier to consumption of fruits and vegetables (Hearn et al., 1998). The WIC program seeks to address this problem through vouchers and education. WIC education and vouchers have been shown to have an impact on behavior, and improve participants' food consumption, including fruits and vegetables, over time. Research has not adequately investigated the linkages between participation in the WIC program and household food availability. This study seeks to shed light on this potentially important association and determine if WIC participation is associated with household food availability. Finally, the study is responsive to concerns about nonrandom selection bias into the WIC program by employing a two-stage selection model to reduce selection effects influence on food availability.

METHODS

Data

The data for this analysis were drawn from the National Health and Nutrition Examination Survey (NHANES) 2007-08 and 2009-10 Consumer Behavior Survey. The NHANES is a continuous survey conducted by the National Center for Health Statistics, a department within the Centers for Disease Control and Prevention (CDC). NHANES is a cross-sectional survey that uses a stratified, multistage probability design to sample the civilian, noninstitutionalized population residing in the 50 states and the District of Columbia. NHANES collects data on each participant's health by measuring key indicators, like weight, height, cholesterol, and blood sugar. Participants are also surveyed about their household income, use of means tested welfare programs like Medicaid, food stamps, and WIC, and health behaviors and awareness. The Flexible Consumer Behavior Survey is an additional module that is designed to measure food consumption, availability, health knowledge, and attitudes.

Sample and Program Participation Measures

The sample is taken from the NHANES 2007-08 and 2009-10 data waves. The sample for the study was limited to women, as men cannot directly participate in the WIC program. The sample was further limited to women who are pregnant or have a family size of 2 or more, and are between the ages of 15 and 45. The age restriction was chosen to maximize the likelihood of either pregnancy or young children in the home. Finally, the sample is restricted to those women whose annual total household income is less than or equal to 185% of the poverty line. This sample restriction limits the sample to those women who meet the income eligibility criterion with the subsample of women who are income eligible but non-WIC participants serving as the control group.

The primary program variable of interest is WIC participation. Participation in the WIC program was determined if a NHANES survey participant answered yes to having participated in the WIC program in the last 12 months. Program eligibility was determined by setting income at the federal WIC income guideline, which is 185% of the federal poverty threshold. The Supplemental Nutrition Assistance Program (SNAP) participation was also included as a control for its influence as a food subsidy program. The income threshold for SNAP is 130% the federal poverty line, considerably lower than the 185% threshold for WIC participation. SNAP participation is measured by respondents answering yes to participating in SNAP for at least 1 month within the last 12 months. The total amount of participants in the NHANES 2007-2010 is 20,686. When the sample was limited to just women, it was reduced by 10,321. With the age restrictions, the sample was reduced by 6,901 participants. Income restrictions of 185% the federal poverty line reduced the sample by 1,346. Restrictions from family size of two or more or pregnant reduced the sample again by 404. To correct the sample for married individuals with family size of just 2, meaning no children, who were not pregnant, 55 people were eliminated from the sample. The last sample reduction came from the elimination of missing observations on variables. These variables were nativity, causing 1 eliminated, minutes to the store, resulting in 179 eliminated, and 1 eliminated from missing observation for vegetables availability. The final sample had 1,478 participants.

Measures

For this study, the dependent variable is a measure of household food availability. Food availability is measured with five questions, each with a 4-point scale ranging from always (1) to never (4). The items ask about whether the following foods are available in the home: fruits, green leafy vegetables, and low-fat milk, as well as chips and crackers. These measures were reverse coded so a positive coefficient would represent a move closer to always (4) and negative coefficient is a move closer to never (1) on the scale. Each measure is considered as an individual outcome measure of food availability.

The key independent variable for this study is WIC participation. Independent control variables are race/ethnicity, family size, acculturation or nativity, educational attainment, marital status, distance to store, main food shopper, age, income to poverty ratio, labor force participation, year, season of survey, income to poverty ratio, SNAP participation, food security, belief that your diet needs to change, and self-reported overweight status. Race/ethnicity is measured in the NHANES through self-report, where respondents can choose 1 of 5 categories: Mexican American, Other Hispanic, Non-Hispanic White, Non-Hispanic Black, or Other. Four dummy variables were created for race: Hispanic, Black, White, and Other. A dummy variable was created for family size where a value of one indicates families of two or more.

The NHANES has multiple different measures for acculturation; for this study, U.S. born was chosen to represent acculturation. A dummy variable for nativity was created and used. Dummy variables for education were created after combining the education measure for those less than 20 years old and those that are over 20 years old: less than high school, high school or GED, some college, and college plus. The variable for less than high school was used as the reference variable, because the greatest effect on food availability was believed to be greatest for the least educated. A dummy variable was created for marital status. Individuals were coded as married if they reported being married or cohabitating; the dummy variable had 1 equaling married and 0 equaling not married. Distance to the store is not measured in miles, but in minutes in the NHANES data and is left as is for the analysis. Main food shopper is a variable that asks if the respondent is responsible for the bulk of food shopping in their home. A dummy variable was created where 1 equals yes and 0 equals no. Age is restricted to 15-45 years old, and remained continuous for the analysis.

The NHANES variable of income to poverty ratio was used to measure income. Income to poverty ratio measures income in relation to the poverty line for a respondent's family size. This allowed for a standardized measure of income in the sample. Labor force participation is measured by self-reported employment status. A dummy variable was created where 1 indicated employed individuals. The employment variable does not discriminate against part-time and full-time employment. Status as a student was not factored into the employment variable creation. A

dummy variable for year was created where 0 was 2007-08 and 1 was 2009-10. Season of survey administration was created into a dummy variable; 0 represents May through October and 1 is November through April. SNAP participation was measured by NHANES participants answering yes that they have participated and received SNAP benefits within the last 12 months.

A dummy variable for households that are deemed to be food secure was created from the NHANES household food insecurity score 1 equals food secure and 0 equals varying levels of food insecurity. In an attempt to measure possible psychological reasons for WIC participation, variables measuring a belief that a respondent needs to change their diet and self-reported overweight status were used. Self-reported overweight status was used as a proxy measure for obesity. A dummy variable was created where 1 equals the belief that you are overweight and 0 equals the belief that you are the right weight or too skinny. A dummy variable was also made for belief that respondent needs to change their diet, with 1 equaling that belief and 0 indicating the disagreement with the statement.

Analytic Strategy

This study addressed the potential selection bias with respect to self-selection into the WIC program by modeling these data with a treatment-effects model, which uses a two-step consistent estimator (Long, 1997). The treatment-effects model considers the effect of an endogenously chosen binary treatment on another endogenous continuous variable. For this study, the treatment was defined as participation in the WIC program, and the endogenous dependent variable is food availability.

The two-stage equation is represented by two equations. The first is represented by

$$y_i=x_i\beta+w_i\delta+\varepsilon_i$$

where y_i equals the dependent variable of food availability and x_i was the vector of independent control variables that may affect food availability, which are race/ethnicity, family size, nativity, educational attainment, marital status, labor force participation, income to poverty ratio, shopper, distance to the store, age, self-reported overweight status, belief your diet needs to change, year of survey, season the survey was administered and SNAP participation. Race/ethnicity is

included, because studies have found racial differences in the types of food made available in the home. WIC research has found that Hispanics consume more whole grains and fruit compared to African Americans. Research also found that African Americans had fewer vegetables and fruits available in the home than White respondents (Kong et al., 2012; Kratt et al., 2000). Family size is an important factor because larger families require more food and are more likely to be aware of the food in their home. Larger families might also make different food choices because of the resource strain from more family members.

Prior research on WIC participants found that nativity plays a role in the quality of a person's diet. Foreign-born individuals were found to have healthier diets, and greater consumption of whole grains and vegetables (Kong et al., 2012). Because of this, nativity was chosen as a variable that affects food availability. Education was controlled, because of its likely association with greater fruit and vegetable availability in the home. It is theorized that this association exists because less educated individuals are less likely to be informed concerning nutrition guidelines and they are less likely to purchase fruits and vegetables. Research on food label use by Wojcicki and Heyman (2011) found that women with less than a high school education were less likely to use nutrition facts than women with some college or more (Wojcicki & Heyman, 2011). Marital status is used as a control variable for food availability, because married persons have to buy food that matches both individuals' food preferences, so the types of food purchased and subsequent availability change depending on the persons in the marriage. Distance measured in time to the store is an important variable to control, because people make different product choices if it takes longer to get to the store than if they are close by, especially for perishables like milk and fresh fruits and vegetables. This means that measures of fruit and vegetable availability are likely to be lower the larger the distance from the store a person is. Distance to the store, or rather the store is close to home, is consistently ranked as an important factor when food shopping (Krukowski, Sparks, DiCarlo, McSweeney, & Smith West, 2013). Age acts as a control variable for any age and cohort effects in the food market. Labor force participation was controlled for because women who work make different choices for meals and shopping than nonworking women.

Labor force participation imposes time constraints on women, especially if they are the primary meal planners and preparers. Research has shown that women who work outside of the home are more likely to purchase pre-prepared meals (Jackson, McDaniel, & Rao, 1985). Income was controlled for, because research has consistently found that income is largely associated with greater food availability. This is because people with larger incomes have greater discretionary income and can afford to purchase more food, especially fruits and vegetables (Ding et al., 2012). Main food shopper is an important variable because they are more likely to be aware of what food is purchased and subsequently available in the home. Self-reported overweight status was used to try to capture psychological effects on food availability. The reason it is likely to affect food availability is because a person who is overweight may purchase more fruits and vegetables and less soda in order to lose weight. Another variable that attempts to capture psychological effects on food availability is the belief your diet needs to change. This variable likely influences purchasing patterns in favor of more availability for fruits and vegetables.

The year of the survey was controlled for to capture variations resulting from large changes in the economy like the great recession of 2008. Season that the survey was administered was controlled for because of its potential effect on the availability of foods; for example, green vegetables are not locally available or in season if you took the survey during the winter. SNAP was used as a control for food availability. SNAP is an entitlement program designed specifically to help low-income participants improve their access to food. SNAP participation needs to be controlled for because SNAP should be associated with increased food availability. Because of its entitlement status, there are no constraints on the number of people who can use the program, as long as their household income is less than 130% of the poverty line.

w_i represents the selection equation for WIC participation and ε_i is for error. The equation for WIC selection represented as:

$$w_i = z_i Y + u_i$$

where w_{in} is WIC participation and z_i is the vector of control variables for WIC participation. These variables include education, race/ethnicity, labor force participation, income, and food

security, belief that your diet needs to change, self-reported overweight status, marital status, year of survey, and season of survey administration. In a study by Bilter and Currie (2004) predicting WIC participation, education was found to be negatively associated with WIC participation; the higher education an individual has, the less likely they are to participate. In fact, their logistic regression found that those who completed a 4 year degree were 46% less likely to participate in WIC than a high school graduate (M. P. Bitler & Currie, 2004). This is most likely because education increases access to better employment and a greater likelihood for promotions. Labor force participation predicted WIC participation. This is likely because employed individuals have greater time constraints, which reduces their probability of participation because enrolling in WIC involves a significant time commitment.

Income varies within the WIC eligible population and income is an important predictor because persons with higher incomes have more resources to spend on food, and have less need for a food supplement, so higher income individuals are less likely to participate. Food insecurity is a composite measure of hunger and food availability. Food insecurity is used to predict WIC participation, because a person who is hungry looks to find extra food sources to reduce their own hunger and WIC provides a food subsidy. Marital status was used to predict WIC participation. Wojcicki and Haymen (2011) found that WIC participants were less likely to be married than nonparticipants (Wojcicki & Heyman, 2011). Marital status is likely to make a difference, because married individuals have an expanded network, in-laws as well as parents, to draw on for help than nonmarried individuals.

Race/ethnicity has been shown to predict WIC participation. M.P. Bitler and Currie (2004) found that being Black produced a 49% increase in the probability of WIC participation compared to Whites. Being Hispanic produced a 55% increased probability for participation compared to Whites (M. P. Bitler & Currie, 2004). This could be because Blacks and Hispanics have access to fewer family resources than Whites to help them acquire food. M.P. Bitler and Currie (2004) also found that obesity produced a greater probability of WIC participation, with a 59% increased probability of participating compared to individuals who were not obese. Obesity is a difficult predictor to understand; M.P. Bitler and Currie admit that they are not sure how it influences WIC

participation (M. P. Bitler & Currie, 2004). Obesity may actually be capturing psychological characteristics, like wanting to improve access to healthier food nutrition knowledge, both of which WIC provides through vouchers and education. The variable that was used, self-reported overweight, captures the psychological characteristics because it is a measure of a participant's belief that they are overweight. The individuals that believe they are overweight may be more likely to choose healthier options. Another variable that captures the psychological aspects of diet choice is the belief your diet should change. Since WIC provides nutrition education, it is likely that someone who thinks their diet needs to change is more motivated to learn about healthy nutrition and more likely to participate in WIC. The survey year is important in predicting WIC because of larger changes in the world. This is evidenced by the economic recession in 2008. If people lose their jobs or their hours were reduced, they may be more likely to participate in WIC. Season is important in predicting WIC because of the variation in food that is available and the price fluctuations as a result.

One essential characteristic of the two-stage model is that controls for the independent variables in the food availability equation (x_i) and the independent variables in the WIC participation equation (z_i) can be the same (Long, 1997). This means that there can be overlap in factors expected to affect WIC participation and factors expected to affect overall food availability.

The statistical software package STATA was used to run the two-stage regression to control for WIC selection. The variables used to predict WIC participation in the two-stage switching regression model were used to estimate the propensity score for WIC participation.

For comparison purposes, an OLS regression, or naïve model, was constructed. This naïve model shows the effect of WIC participation on household food availability without any treatment estimates. The naïve model does not account for self-selection but was used to provide initial estimates that were compared to the estimates obtained from the two-stage switching regression to address for self-selection into the WIC program.

Hypotheses

The hypotheses used reflect the main objective of the WIC program, namely to improve a participants' diet. Literature may not support the hypotheses, but it is hypothesized that WIC participation will impact food availability. Specifically,

1. WIC participation will be associated with an increase in household dark leafy green vegetable and fruit availability, holding other factors constant.
2. WIC participation will be associated with a decrease in household salty snack availability, holding other factors constant.
3. WIC participation will be associated with a decrease in household soda availability, holding other factors constant.
4. WIC participation will be associated with an increase in household low-fat and skim milk availability, holding other factors constant.

RESULTS

Table 1 presents the summary statistics for the whole sample, and also separately for WIC participants and nonparticipants. Two tail *t*-tests were conducted to establish statistically significant differences between the groups in the unweight sample. The average age of WIC participants is 28.08 years and the average age of nonparticipants is approximately 3 years older, at 31 years. *T*-test analysis revealed that the difference is statistically significant ($p<.01$). Average income to poverty ratio for WIC participants is .94, or, on average, participants 'income is 94% the poverty threshold. Nonparticipants on average have an income to poverty ratio of 1.57, or 157% of the poverty threshold. The difference between means is 63 percentage points and is statistically significant ($p<.01$). The proportion of WIC participants who are U.S. citizens is .70 and nonparticipants is .79; the difference is statistically significant ($p<.01$). Forty-two percent of WIC participants are employed compared to 55% of nonparticipants, with the difference being statistically significant. Non-participants are more food secure than participants, 53% vs. 39% ($p<.01$). More WIC participants are Latino compared to nonparticipants, 39% and 23%, respectively ($p<.01$). Fifty-one percent of WIC participants are married compared to 44% of nonparticipants who are married. *T*-test revealed that the difference in marital status is statistically significant ($p<.05$). WIC participants also have an average family size of 4.67 compared to slightly over 4 for nonparticipants ($p<.01$). Forty-five percent of WIC participants have less than a high school degree compared to 34% of nonparticipants ($p<.01$). WIC participants are more likely to be the main shopper than nonparticipants, with 74% of participants being the main food shopper compared to 68% of nonparticipants ($p<.01$). SNAP participation for WIC participants is significantly different ($p<.01$) than nonparticipants with, 61% of WIC participants using SNAP and 32% of nonparticipants using SNAP.

Table 2 shows the naïve model for household food availability by food category. WIC participation is not associated with any food availability category. Family size shows a positive statistically significant association with dark green leafy vegetables and fruit ($p<.01$) and positive association for soda availability ($p<.05$). The income-to-poverty ratio variable demonstrates a statistically significant positive association with dark green leafy vegetables, fruit, and low-fat milk ($p<.01$). Black racial identification is negatively associated with fruit, salty snacks, and low-fat milk ($p<.01$). Latino ethnic identity is negatively associated with low-fat milk ($p<.05$) and soda availability ($p<.01$) and has negative moderately statistically significant association with salty snack availability ($p<.1$). U.S. born has a statistically significant negative association with dark leafy green vegetables and fruit ($p<.05$) and low-fat milk ($p<.01$) and is also positively associated with salty snack household availability ($p<.01$). Less than high school education is negatively associated with a moderately statistically significant decrease in fruit availability ($p<.1$). Less than high school education is negatively associated with low-fat milk availability and is also associated with an increase in soda availability ($p<.05$). Age has a statistically significant negative association with low-fat milk ($p<.05$), and a statistically significant negative association with soda availability ($p<.01$). Marital status is negatively associated with dark leafy green vegetables ($p<.05$) and has a moderately statistically significant positive association with soda availability ($p<.1$). Self-report overweight status is negatively associated with fruit availability ($p<.05$) and has moderately statistically significant positive association with low-fat milk ($p<.1$). Year of survey[1] has a moderately statistically significant negative association with salty snack household availability ($p<.1$) and a statistically significant negative association with soda availability ($p<.01$).

[1] In subsequent sensitivity testing, an interaction term for WIC participation and year of survey was created. This interaction term was included in alternate models to test for whether the effects of WIC participation varied by the year of survey wave. The interaction term was not significant and did not change the results for either the naïve or two-stage models.

SNAP participation[2] had no effect on any household food availability measure.

Table 3 shows the results of the WIC selection portion of the switching regression equation. Identifying as Black is associated with an increase in WIC participation compared to Whites ($p<.05$). Latino ethnicity is also associated with an increase in WIC participation relative to Whites ($p<.01$). Age is negatively associated with WIC participation ($p<.01$). An increase in the income-to-poverty ratio variable is associated with a decrease in WIC participation ($p<.01$). Marriage, in this sample, is associated with an increase in WIC participation ($p<.01$), contrary to original assumption that hypothesized a negative effect on WIC participation. Self-reported overweight status has a moderately statistically significant association, with an increase in the likelihood of WIC participation relative to those who do not think they are overweight ($p<.1$). Season of the surveys administration is also has a moderately statistically significant negative association with WIC participation ($p<.1$).

Table 4 shows the results of WIC participation with the self-selection taken into account, as well as other control variables. Unlike the naïve model, WIC participation, when controlling for self-selection, has an effect on all household food availability categories. WIC participation shows a negative statistically significant ($p<.05$) association with dark leafy green vegetable availability and fruit availability. In addition, WIC participation shows a moderately statistically significant positive association ($p<.1$) with low-fat milk availability and a moderately statistically significant negative association with salty snack availability ($p<.1$). WIC participation is also negatively associated with soda availability ($p<.05$) compared to nonparticipants.

Being U.S. born also posts a negative association with dark leafy green vegetables and fruit availability relative to being foreign born ($p<.01$). U.S. born is also negatively associated with low-fat milk availability ($p<.01$). U.S. born is positively associated with increased salty snack availability ($p<.01$). These results are similar to the naïve model. Black race identification is

[2] During data analysis, there was concern over WIC and SNAP participations potential co-linearity. The correlation coefficient was .22 and was statistically significant ($p<.05$), representing a weak association. Analysis was run with and without SNAP participation to determine its effect on the results. SNAP participation did not impact the results of WIC participation in either the naïve or two-stage model. In order to protect from omitted variable bias and because the correlation was weak, SNAP participation was controlled for in the final equation.

negatively associated with fruit availability (p<.05) and it is still negatively associated with low-fat milk availability (p<.01), but is no longer associated with salty snack household availability. Unlike the naïve model estimates, income-to-poverty ratio variable is only positively associated with low-fat milk availability (p<.01) and has no association with fruit, and a statistically significant negative association with soda availability (p<.05).

When controlling for WIC self-selection, age is negatively associated with fruit (p<.05) and soda availability (p<.01). The negative association between age and soda availability is consistent between the naïve and two-stage model. Like the naïve model, Latino identity is negatively associated with low-fat milk availability (p<.01) and soda availability (p<.05). Family size, like the naïve model, posts a positive statistically significant association for dark green leafy vegetables and fruit (p<.01) and a positive association with soda availability (p<.05). Unlike the naïve model, employment has a moderately statistically significant negative association for dark green leafy vegetables (p<.1) and a statistically significant negative association with fruit availability (p<.05). Like the naïve model, less than high school education is associated with fruit availability, but its significance has changed to a moderately statistically significant association (p<.1). Less than high school has a statistically significant negative association with low-fat milk (p<.01) and a positive moderately statistically significant association with soda availability (p<.1), unlike the naïve model.

Being the primary food shopper is associated with a statistically significant increase in fruit and soda availability (p<.05). The belief that diet should change has a moderately statistically significant positive association with fruit availability and a moderately statistically significant negative association with soda availability (p<.1). Belief that diet should change also is positively associated with low-fat milk availability and the relationship is statistically significant (p<.01). The year the survey was taken was associated with a decrease in soda availability (p<.01) and an increase in fruit availability (p<.05). The survey year also has a moderately statistically significant positive association with low-fat milk availability (p<.1).

DISCUSSION

The aim of this study was to assess the association between WIC participation and household food availability, while addressing concerns of self-selection regarding WIC participation. WIC participation was associated with all food availability categories when controlling for WIC self-selection in the two-stage switching regression. The switching regression reveals that WIC participation is negatively associated with fruit and dark leafy green vegetable availability. This means that WIC participation reduces household availability for these categories. This is contrary to the stated goals of the WIC program and is counter to the hypotheses of this study. One explanation may be the WIC vouchers for fruits and vegetables value is too low to improve fruit and dark leafy green vegetable availability for participants. This is consistent with arguments made by M. Bitler and Curie in prior research, considering the food and vegetable vouchers are worth 10 dollars for adults and 6 dollars for children per month (M. Bitler et al., 2005). Whaley et al. found that despite the changes to the vouchers in 2009, fruit and vegetable consumption did not increase, which implies that household fruit and vegetable availability did not increase in a statistically significant way (Whaley et al., 2012). Another explanation may be that a substitution effect may also be at work for WIC participants. This effect may be seen when participants use the money they would have used for foods that are covered by the vouchers on other items, like rent. Lastly, another reason could be that the education component of the program does not cause changes to behavior. However, the first two explanations are more probable, because studying the education portion of the WIC program would be difficult because the education varies by state. Testing the education program would also require a randomized trial, which is difficult to implement for a public program like WIC. It is also possible that the self-selection control method is not fully capturing some of the variables that are influencing selection. This is probably due to omitted variables like prices.

WIC participation was found to decrease the availability of soda and salty snacks in the home. This finding is important because it shows that despite the decreases in dark leafy green vegetable and fruit availability, the program may benefit participants in other ways. The finding of the negative association between WIC participation and soda availability is interesting, because research by Andreyeva et al. (2012) found an increase in soda purchases by WIC participants compared to nonparticipants (Andreyeva et al., 2012). This could be because WIC participants have vouchers for fruit juice and milk so their beverage needs are met by different products, or the nutrition education against soda drinking is more effective than the education to eat more fruits and vegetables. The finding that WIC participation is negatively associated with salty snacks household availability is encouraging, especially considering the negative association of WIC participation to fruits and vegetables. This could be the result of nutrition education emphasizing the concept that salty snacks are empty calories, or the participants are more likely to buy sweet snacks instead of salty snacks. Participants are not asked about sweet snacks, so participants could be eating snacks, just not ones asked about on the NHANES. It is also possible that education messages discouraging the purchase of items like soda are easier to follow than messages encouraging the purchase of vegetables. Purchasing additional items like vegetables requires more knowledge to prepare and consume them.

Tests for selection are consistent with previous research, in that identifying as Black and Latino is associated with an increase in WIC participation (M. P. Bitler & Currie, 2004). Tests for selection also revealed that income is an important predictor of WIC participation. Higher income adjusted for needs was associated with a reduction in WIC participation. This makes sense if a person uses WIC vouchers as cash. If WIC vouchers are used as cash, then there is a threshold when the income gained from the vouchers does not outweigh the time to acquire the vouchers. Self-reported overweight status is also associated with an increase in WIC participation. Since this variable is not an objective measure of overweight or obesity, the variable was chosen to better understand the psychological choice behind participation. This association may be from a person's desire to get nutrition education or improve their access to healthier food. Associations with WIC participation are witnessed in other research, but is not understood as to why the

association exists (M. P. Bitler & Currie, 2004). Food secure status was used to estimate the likelihood of participation with the expectation that those that are food secure would be less likely to participate. The result was not statistically significant; this could be because food security can be measured in multiple ways, and it is probable that the measure of food secure status used was not accurately predicting behavior. This is surprising considering that prior food security research has found that WIC participants are more food insecure than nonparticipants (M. Bitler et al., 2005). Understanding the relationship between food security and WIC participation warrants further study and may better help future research predict WIC participation.

Most surprisingly, marital status is the strongest predictor in this study for WIC participation. This is contrary to the original reasoning of why marital status is a predictor for WIC participation, and is in contrast to previous research. Previous research found that WIC participants are less likely to be married (Wojcicki & Heyman, 2011). For this study, marital status is a statistically significant predictor of WIC participation ($p<.01$). Marital status may be associated with WIC participation because of the time costs associated with participation. Married women may not be the primary provider, giving them more flexibility to go to the WIC clinic.

The data analysis revealed that for this sample, WIC participations negative effect was neutralized by positive self-selection effects, or that the more motivated individuals who do better on outcomes participated. The difference can be seen when comparing the naïve model to the switching regression. This would explain the negative effect found in dark leafy green vegetables and fruit availability after correcting for selection. This also makes sense since participation requires setting aside time in your schedule for an appointment, visiting a WIC clinic, waiting for the appointment in a waiting room, and scheduling additional follow-up appointments.

A finding that is consistent in both the naïve and switching models is the association between fruit and dark leafy green vegetable availability and family size. This could be because people who have larger families shop more often and are more aware of what they have in their homes. It could be that since their family is larger they choose to not purchase salty snacks and purchase more fruit and vegetables. Less than high school education is associated in both the naïve and switching regression models with a decrease in availability of low-fat milk and fruit and

an increase in the availability of soda. This association is likely a result of a lack of education on proper nutrition, a finding supported by the food label research by Wojcicki and Heyman (Wojcicki & Heyman, 2011). Another noteworthy finding is the negative association of U.S. born and fruit, milk, and dark leafy green vegetable availability. U.S. born is also associated with an increase in the availability of salty snacks. U.S. born is used to estimate acculturation, and as such, these results indicate that the U.S. culture is associated with unhealthy food availability patterns. This is likely because of the food culture in America emphasizes fast, cheap, and processed foods. This finding is consistent with prior research by Kong et al., who found that WIC participants who scored lower on acculturation measures had healthier diets than participants with higher scores

Limitations

Overall, the findings concerning WIC participation should be interpreted with caution. This study did use some key variables to simulate WIC selection, but fell short on the key issue of geographic variability. States can add additional participation requirements and states choose WIC office locations. WIC participants have to physically go to WIC offices for appointments, with some offices having longer wait times than others. This presents a time cost to participation that this study was unable to measure, representing a weakness in the WIC participation estimates. Second, the measures for food availability are not objectively measured in the NHANES but rather are self-reported by NHANES participants. This means that the household food availability measures are subject to recall bias and social desirability bias. Future research should consider an objective food availability measure, or maybe how often a person purchases fruit and vegetables for their availability measures. Future research that seeks to control for self-selection into WIC participation should consider using variables that estimate time costs to participation, like state WIC requirements and average wait times.

Another limitation from the food availability measures is that they do not measure protein or fatty foods in participant's diets. WIC vouchers are redeemable for many foods like peanut butter, milk, 2% and whole, and eggs. These products are rich with protein and fats, and if the NHANES had measured protein or fat, WIC participation would likely be associated with

increases in these categories. Future research should consider adding categories for fat and protein in addition to current categories used in this study. A limitation to this study is the lack of a measurement for children in the WIC program requirements. The NHANES does not link children to adults to be grouped into families. This means that in this study, some nonparticipants had all their children over the age of 6, which is the cut off age for WIC participation.

Policy and Research Implications

Despite the weaknesses of this study, the findings do present policy makers with direction for future WIC policy and research. Increases in the dollar amount of fruit and vegetable vouchers may improve the association between WIC participation and dark leafy green vegetables and fruit household availability. Prior research by Black et al. (2009) found that WIC participants usually purchase the food made available by the vouchers, so this is a promising strategy to improve WIC participants' household fruit and vegetable availability (Black et al., 2009). Research by Herman et al. (2006) was done to find the effect of women receiving a fruit and vegetable voucher before the 2009 WIC voucher change that added fruit and vegetable vouchers. They provided a larger voucher subsidy than the current WIC program offers; $40 verses $10 for adult women. They found that these women used all the vouchers for fruit and vegetables, but they did not measure the effect this had on their household food availability (Herman et al., 2006). Research similar to Herman et al. (2006) could be done with the addition of fruit and vegetable availability measures.

Future research focusing on the educational component of WIC could implement a new education plan, and follow WIC participants' purchasing behaviors to determine the impact on food choice and household food availability. This would overcome the potential biases associated self-reported food availability levels. This could be done using a similar method, as the study by Andreyeva et al. (2012), who used grocery store loyalty card data to follow sugary sweetened beverage purchases of WIC and SNAP participants for several months (Andreyeva et al., 2012)

Conclusion

This study sought to establish WIC participation's effect on household food availability using the NHANES 2007-2010 data waves, while correcting for WIC self-selection. To the author's knowledge, this study is the first of its kind to address the question of whether WIC participation affects household food availability. The study found that WIC participation is negatively associated with the availability of dark leafy green vegetables, fruits, soda, and salty snacks, and it is positively associated with low-fat milk availability, using a two-stage switching regression model to correct for selection.

Table 1. Weighted summary statistics by WIC participation						
	Whole Sample (*N*=1478)		WIC participants (*N*=477)		Non-participants (*N*=1001)	
	Mean	Stan. Dev	Mean	Stan. Dev	Mean	Stan. Dev
Vegetable Availability[1,2]	4.23	.99	4.25	.95	4.23	1.00
Fruit availability[1]	4.43	.81	4.42	.81	4.43	.82
Milk availability[1,3]	2.15	1.66	2.03	1.62	2.19	1.68
Soda availability[1]	3.72	1.33	3.84	1.31	3.67	1.33
Salty snack availability[1]	3.81	1.12	3.77	1.10	3.83	1.12
Black	.19	.39	.22	.42	.18	.38
Latino	.27	.44	.39	.49	.23	.42
Other	.07	.25	.04	.20	.08	.26
Age	30.19	8.73	28.08	7.81	31.00	8.94
Marital status	.46	.50	.51	.50	.44	.50
<high school	.37	.48	.45	.50	.34	.48
U.S. born	.77	.42	.70	.46	.79	.41
Family size	4.21	1.43	4.67	1.55	4.04	1.33
Employed	.51	.50	.42	.49	.55	.50
Income to poverty ratio	1.39	1.01	.94	.59	1.57	1.09
SNAP participation	.40	.50	.61	.49	.32	.47
Food secure	.49	.50	.39	.50	.53	.50
Belief in diet change	.54	.50	.52	.50	.55	.50
Self-reported overweight status	.58	.50	.60	.49	.57	.49
Minutes to the store	15.92	19.29	15.79	18.98	15.97	19.41
Primary Food Shopper	.70	.46	.74	.44	.68	.47
Season survey administered	.49	.50	.42	.49	.52	.50

[1] (1=never, 5=always)
[2]= Dark leafy green vegetables
[3]=Low-fat or skim milk

Table 2. Naïve OLS regression model for each food availability category (*N*=1478)					
	Vegetable[1]	Fruit	Milk[2]	Salty Snack	Soda
	Coef. (S. E.)	Coef. (S. E.)	Coef. (S. E.)	Coef. (S. E.)	Coef. (S. E.)
WIC participation	-.03 (.06)	.00 (.05)	.01 (.10)	-.02 (.07)	.04 (.08)
Black	.06 (.07)	-.22*** (.06)	-.44*** (.12)	-.22*** (.09)	.00 (.10)
Latino	-.10 (.08)	-.11 (.06)	-.30** (.12)	-.16* (.09)	-.41*** (.10)
Other	.07 (.13)	.02 (.11)	.03 (.21)	-.19 (.15)	-.66*** (.17)
Age	.00 (.00)	.00 (.00)	-.01** (.01)	.00 (.00)	-.01*** (.00)
Marital status	-.15** (.06)	-.01 (.05)	.02 (.10)	.02 (.07)	.15* (.08)
<high school	-.06 (.06)	-.08* (.05)	-.22** (.09)	.05 (.06)	.16** (.08)
U.S. born	-.18** (.07)	-.15** (.06)	-.32*** (.12)	.36*** (.08)	.03 (.10)
Family size	.06*** (.02)	.07*** (.02)	.03 (.03)	.03 (.02)	.05** (.03)
Employed	-.08 (.05)	-.09* (.04)	.09 (.09)	.00 (.06)	.01 (.07)
Income to poverty ratio	.10*** (.03)	.10*** (.03)	.19*** (.05)	.04 (.04)	-.04 (.05)
SNAP participation	.08 (.06)	-.02 (.05)	.04 (.09)	.04 (.07)	.07 (.08)
Minutes to the store	.00 (.00)	.00 (.00)	.00 (.00)	-.00* (.00)	.00 (.00)
Primary food shopper	.04 (.07)	-.13 (.06)	-.01 (.11)	.05 (.08)	.20** (.09)
Belief in diet change	-.01 (.05)	.09** (.04)	.33*** (.08)	.06 (.06)	-.12* (.07)
Self-reported overweight status	-.08 (.05)	-.11** (.04)	.14* (.09)	-.02 (.06)	-.09 (.07)
Year of survey	.00 (.05)	.07 (.04)	.22 (.08)	-.11* (.06)	-.31*** (.07)
Season survey administered	.03 (.05)	.03 (.04)	.06 (.09)	.07 (.06)	.02 (.07)

[1]= Dark leafy green vegetables
[2]=Low-fat or skim milk
*=p<.1
**= p<.05
***=p<.01

Table 3. WIC selection results of switching regression (*N*=1478)		
	Coef.	S.E.
Black	.26**	.11
Latino	.35***	.09
Other	.01	.18
Age	-.03***	.00
Marital status	.46***	.08
<high school	-.01	.08
Employed	-.07	.07
Income to poverty ratio	-.53***	.06
Food secure	-.10	.07
Belief in diet change	-.03	.07
Self-reported overweight status	.13*	.07
Year of survey	.09	.07
Season survey administered	-.13*	.07

*=$p<.1$
**= $p<.05$
***=$p<.01$

Table 4. Two stage switching regression model by food availability category (*N*=1478)					
	Vegetable[1]	Fruit	Milk[2]	Salty Snack	Soda
	Coef. (S. E.)	Coef. (S. E.)	Coef. (S. E.)	Coef. (S. E.)	Coef. (S. E.)
WIC participation	-95** (.47)	-.83** (.40)	1.40* (.76)	-.98* (.54)	-1.50** (.65)
Black	.13 (.09)	-.16** (.07)	-.54*** (.14)	-.15 (.10)	.11 (.12)
Latino	-.00 (.09)	-.02 (.08)	-.45*** (.15)	-.06 (.11)	-.25** (.13)
Other	.06 (.14)	-.04 (.12)	.06 (.22)	-.21 .16	-.70*** (.19)
Age	-.01 (.01)	-.01** (.00)	.00 (.01)	-.01 (.01)	-.03*** (.01)
Marital status	-.02 (.09)	.11 (.08)	-.18 (.15)	.16 (.11)	.37*** (.13)
<high school	-.06 (.06)	-.08* (.05)	-.21** (.10)	.04 (.07)	.15* (.08)
U.S. born	-.18*** (.07)	-.16*** (.06)	-.31*** (.17)	.35*** (.08)	.05 (.10)
Family size	.06*** (.02)	.07*** (.02)	.03 (.03)	.03 (.02)	.05** (.03)
Employed	-.11* (.06)	-.11** (.05)	.12 (.09)	-.03 (.07)	-.02 (.08)
Income to poverty ratio	-.01 (.07)	-.00 (.06)	.37*** (.11)	-.08 (.08)	-.23** (.10)
SNAP participation	.09 (.06)	-.01 (.05)	.02 (.09)	.06 (.07)	.10 (.08)
Minutes to the store	.00 (.00)	.00 (.00)	.00 (.00)	-.00* (.00)	.00 (.00)
Primary food shopper	.05 (.07)	.13** (.06)	-.02 .11	.06 .08	.21** .09
Belief in diet change	-.02 (.06)	.08* (.05)	.35*** (.09)	.04 (.06)	-.15* (.08)
Self-reported overweight status	-.05 (.06)	-.08 (.05)	.09 (.10)	.02 (.07)	-.03 (.08)
Year of survey	.03 (.06)	.10** (.05)	.18* (.09)	-.08 (.07)	-.27*** (.08)
Season survey administered	.00 (.06)	.00 (.05)	.11 (.10)	.04 (.07)	-.04 (.08)

[1]= Dark leafy green vegetables
[2]=Low-fat or skim milk
*=$p<.1$
**= $p<.05$
***=$p<.01$

REFERENCES

Andreyeva, T., Luedicke, J., Henderson, K. E., & Tripp, A. S. (2012). Grocery store beverage choices by participants in federal food assistance and nutrition programs. *American Journal of Preventive Medicine, 43*(4), 411-418.

Birch, L. L. (1999). Development of food preferences. *Annual Review of Nutrition, 19*(1), 41.

Bitler, M., Gundersen, C., & Marquis, G. S. (2005). Are WIC nonrecipients at less nutritional risk than recipients? An application of the food security measure. *Review of Agricultural Economics, 27*(3), 433-438.

Bitler, M. P., & Currie, J. (2004). Does WIC work? The effects of WIC on pregnancy and birth outcomes. *Journal of Policy Analysis and Management, 24*(1), 73-91.

Black, M. M., Hurley, K. M., Oberlander, S. E., Hager, E. R., McGill, A. E., White, N. T., & Quigg, A. M. (2009). Participants' Comments on Changes in the Revised Special Supplemental Nutrition Program for Women, Infants, and Children Food Packages: The Maryland food preference study. *Journal of the American Dietetic Association, 109*(1), 116-123. doi: http://dx.doi.org/10.1016/j.jada.2008.10.016

Cole, N., Jacobson, J., Nichols-Barrer, I., & Fox, M. K. (2011). *WIC food packages policy options study*. Alexandria, VA: United States Department of Agriculture.

Cullen, K. W., Baranowski, T., Owens, E., Marsh, T., Rittenberry, L., & De Moor, C. (2003). Availability, accessibility, and preferences for fruit, 100% fruit juice, and vegetables influence children's dietary behavior. *Health Education and Behavior, 30*(5), 615-626.

Ding, D., Sallis, J. F., Norman, G. J., Saelens, B. E., Harris, S. K., Kerr, J., . . . Glanz, K. (2012). Community food environment, home food environment, and fruit and vegetable intake of children and adolescents. *Journal of Nutrition Education and Behavior, 44*(6), 634-638.

Hanson, N. I., Neumark-Sztainer, D., Eisenberg, M. E., Story, M., & Wall, M. (2004). Associations between parental report of the home food environment and adolescent intakes of fruits, vegetables and dairy foods. *Public Health Nutrition, 8*(1), 77-85. doi: 10.1079/PHN2004661

Havens, E. K., Martin, K. S., Yan, J., Dauser-Forrest, D., & Ferris, A. M. (2012). Federal nutrition program changes and healthy food availability. *American Journal of Preventive Medicine, 43*(4), 419-422.

Hearn, M. D., Baranowski, T., Baranowski, J., Doyle, C., Smith, M., Lin, L. S., & Resnicow, K. (1998). Environmental influences on dietary behavior among children: Availability and accessibility of fruits and vegetables enable consumption. *Journal of Health Education, 29*(1), 26-32. doi: 10.1080/10556699.1998.10603294

Herman, D. R., Harrison, G. G., Afifi, A. A., & Jenks, E. (2008). Effect of targeted subsidy on intake of fruits and vegetables among low-income women in the Special Supplemental

Nutrition Program for Women, Infants, and Children. *American Journal of Public Health, 98*(1), 98-105. doi: 10.2105/AJPH.2005.079418

Herman, D. R., Harrison, G. G., & Jenks, E. (2006). Choices made by low-income women provided an economic supplement for fresh fruit and vegetable purchase. *Journal of the American Dietetic Association, 106*(5), 740-744. doi: 10.1016/j.jada.2006.02.004

Hillier, A., McLaughlin, J., Cannuscio, C. C., Chilton, M., Krasny, S., & Karpyn, A. (2012). The impact of WIC food package changes on access to healthful food in 2 low-income urban neighborhoods. *Journal of Nutrition Education and Behavior, 44*(3), 210-216.

Jackson, R. W., McDaniel, S. W., & Rao, C. P. (1985). Food shopping and preparation: Psychographic differences of working wives and housewives. *Journal of Consumer Research, 12*(1), 110-113.

Kong, A., Odoms-Young, A. M., Schiffer, L. A., Berbaum, M. L., Porter, S. J., Blumstein, L., & Fitzgibbon, M. L. (2012). Racial/Ethnic differences in dietary intake among WIC families prior to food package revisions. *Journal of Nutrition Education and Behavior, 45*(1), 39-46.

Kratt, P., Reynolds, K., & Shewchuk, R. (2000). The role of availability as a moderator of family fruit and vegetable consumption. *Health Education and Behavior, 27*(4), 471-482.

Krukowski, R. A., Sparks, C., DiCarlo, M., McSweeney, J., & Smith West, D. (2013). There's more to food store choice than proximity: A questionnaire development study. *BMC Public Health, 13*(1), 1-8. doi: 10.1186/1471-2458-13-586

Langenberg, P., Ballesteros, M., Feldman, R., Damron, D., Anliker, J., & Havas, S. (2000). Psychosocial factors and intervention-associated changes in those factors of change in fruit and vegetable consumption in the Maryland WIC 5 a day promotion program. *Annals of Behavioral Medicine, 22*(4), 307-315.

Long, S. J. (1997). *Regression models for categorical and limited dependent variables* (7th ed.). Indiana University, Bloomington: Sage Publications, Inc.

Martinez-Schiferl, Zedlewski, S., & Giannarelli, L. (2013). *National and state-level estimates of Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) eligibles and program reach, 2010.* Alexandria Virginia: U.S. Department of Agriculture, Food and Nutrition Service, Office of Research and Analysis.

Ritchie, L. D., Whaley, S. E., Spector, P., Gomez, J., & Crawford, P. B. (2010). Favorable impact of nutrition education on California WIC families. *Journal of Nutrition Education and Behavior, 42*(3 suppl. 1), S2-S10. doi: 10.1016/j.jneb.2010.02.014

United States Department of Agriculture. (2012). *Effects of the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC): A review of recent research.* Report WIC-12-WM. Alexandria, VA: United States Department of Agriculture.

United States Department of Agriculture. (2013). *The food assistance landscape FY 2012 annual report.* Economic Information Bulletin No. (EIB-109). Washington, DC: United States Department of Agriculture.

Whaley, S. E., Ritchie, L. D., Spector, P., & Gomez, J. (2012). Revised WIC food package improves diets of WIC families. *Journal of Nutrition Education and Behavior, 44*(3), 204-209. doi: 10.1016/j.jneb.2011.09.011

Wojcicki, J. M., & Heyman, M. B. (2011). Food labels awareness of nutritional programmes and participation in the special supplemental program for Women, Infants and Children (WIC): results from the National Health and Nutrition Examination Survey (2005-2006). *Maternal and Child Nutrition, 9*, 299-308. doi: 10.1111/j.1740-8709.2011.00382x

Zenk, S. N., Odoms-Young, A., Powell, L. M., Campbell, R. T., Block, D., Chavez, N., . . . Armbruster, J. (2012). Fruit and vegetable availability and selection: Federal food package revisions, 2009. *American Journal of Preventive Medicine, 43*(4), 423-428.