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Essays on SNAP Participation, BMI, and Food Purchasing Decisions

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by

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DEDICATION

I dedicate this dissertation to some very important people in my life:

To my beautiful mother, my dedicated father, my lovely sister, my supportive brother, and their wonderful families: Thank you for your unconditional love and inspiration; for believing in me when I succeed and when I fail; for your unwavering patience and support; and for encouraging me to start this journey and complete this dissertation as a major milestone along the journey.

I love you and I always will!

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ABSTRACT

This dissertation estimates the SNAP-eligible individuals' Body Mass Index (BMI) changes by the American Recovery and Reinvestment Act of 2009 (ARRA) in Chapter 1. It also examines whether the food packages' nutrition fact tables' refinements improve SNAP-recipients' healthy food purchasing decisions in Chapter 2. Below, the summary of these chapters are provided:

- Chapter 1: The Effects of the American Recovery and Reinvestment Act of 2009 on the Body Mass Index (BMI) of SNAP-Eligible Individuals
- Chapter 2: Do Changes in the Nutrition Facts Labels Affect SNAP-Participants' Food Purchasing Decisions?

Chapter 1 studies the effects of the American Recovery and Reinvestment Act of 2009 (ARRA) on SNAP-eligible individuals' BMI. The Supplemental Nutrition Assistance Program (SNAP) is the largest program in the U.S. to protect low-income families from hunger. Although decreasing food insecurity is universally approved, the SNAP program is not without its critiques. Many studies have reported a link between participation in SNAP and obesity among the poor. In this study, the effects of an expansion of SNAP benefits on SNAP-eligible individuals' BMI compared to ineligible people are examined. The expansion introduced by ARRA increased the average value of benefits for SNAP recipients by about 13.6% compared to the previous year. Accounting for the endogeneity of an explanatory variable and systematic underreporting of participation status are the primary challenges of finding the SNAP's causal impacts on BMI. The difference-in-differences model is estimated the ARRA-related SNAP-expansion on SNAP-eligible people's

BMI to address the mentioned challenges. Restricted data from the National Longitudinal Survey of Youth 1979 is used, which is a panel of 12,686 individuals aged 14 to 22 years old in the first year of the interview (1979). The fixed-effect estimation results suggest that SNAP expansion increased the BMI rates among SNAP-eligible adults; however, quantile regression shows a different portrait of changes across the whole sample. Although people in lower quantiles of BMI started to lose weight, individuals in higher quantiles reacted significantly different to this event.

Chapter 2 uses an experiment to examine whether changes in the nutrition facts table impact SNAP-participants' food label use and food purchasing decisions. World Health Organization (WHO) declared obesity as the principal cause of preventable mortality. According to the results outlined in Chapter 1, ARRA-related SNAP-expansion increased obesity among SNAP-eligible adults, consistent with previous studies. Income effects can explain these findings; If SNAP-recipients have access to more money, they can buy more energy-density meals high in fat and sugar. Conventional economic models make the assumption that people are rational, prospective, and time-consistent. Consequently, these models are insufficient in understanding why people make unhealthy food decisions. Economists have been using psychology studies in recent years to enhance their traditional models and explain the causes of the obesity crisis and future policy approaches. This study contributes to the existing literature by examining whether SNAP recipients' nutrition fact table viewing and healthy food purchasing are influenced by changing the food labels. Moreover, this chapter studies the possibility of improving the food purchasing decisions by viewing the nutrition facts table. These contributions are made by employing an experiment simulating the shopping experience for SNAP-recipients to analyze whether low-income people's attention to labels change with the nutrition facts table's modifications. The findings suggest that SNAP-recipients' nutrition fact table viewing is influenced by changing the nutrition label's design and location. Furthermore, the IV Probit model's results suggest that people who view the nutrition fact labels while shopping are more likely to choose healthier food items.

CHAPTER 1 : THE EFFECTS OF THE AMERICAN RECOVERY AND REINVESTMENT ACT OF 2009 ON THE BODY MASS INDEX OF SNAP-ELIGIBLE INDIVIDUALS

1.1 Introduction

The Great Recession of 2007-2009 created severe economic upheaval in the United States. This recession disrupted the lives of millions of people in the U.S. through its impact on economic factors. In particular, the number of jobs and the median family income declined by 6% and 8%, respectively (Kalleberg and Von Wachter [2017]), and the unemployment rate doubled compared to its long-term historical value (Song and Von Wachter [2014]).

One of the consequences of such significant disruption in the U.S. economy caused by the recession was that households' food expenditure declined dramatically by 5% - a phenomenon which was unprecedented for at least 25 years (Kumcu and Kaufman [2011]). In response to the Great Recession, The American Recovery and Reinvestment Act of 2009 (ARRA) was enacted in 2009. The primary goal of this act was to prevent further economic depression through an increase in public spending. One goal of ARRA was to boost low-income families' food security. Low-income households' food expenditures increased by 5.4% with ARRA (Nord and Prell [2011]).

To meet this objective, ARRA supported the largest food assistance program in the U.S. by temporarily expanding the benefits this program provides to low-income families to help with their food expenditures. This program is known as the Supplemental Nutrition Assistance Program (SNAP - formerly known as the Food Stamp Program). ARRA increased SNAP benefits by a fixed dollar amount for each household size so that the median value of its benefits was boosted by about 13.6% of the maximum allotment. Furthermore, some SNAP eligibility rules were relaxed by ARRA so that this program could support more households affected by the recession. For instance, for the first time, jobless adults with no child became eligible for the SNAP during ARRA (Nord and Prell [2011]).

As a result of ARRA-related changes in SNAP, participation increased. According to data released by the USDA, SNAP enrollment expanded by 53% from 2007 to 2010, and the number of recipients reached its peak in 2013 with roughly 47 million registrants (FNS). A large and growing body of literature has investigated SNAP participation's causal effect on various health determinants such as dietary intake, food security, and BMI.

SNAP with providing low-income households with more money, encourage buying more food, and increasing BMI. Besides, high in sugar and fat content foods are cheaper and more appealing for SNAP recipients. A great deal of previous research into SNAP participation has focused on BMI, but the evidence is mixed. For example, Gibson [2003], Zagorsky and Smith [2009], Townsend et al. [2001], Chen et al. [2005] find that participation in the SNAP increases BMI; however, Hofferth and Curtin [2005] and Fan [2010] show little to no evidence that SNAP participation affects BMI.

The existing contradiction was the primary motivation of this study. Most of the previously mentioned papers suffer from the systematic under-reporting participation status and endogeneity bias. The first mentioned drawback is the primary obstacle for finding government assistance programs' effects on various economic and health factors. The comparison of SNAP-eligible with SNAP-ineligible households to address the problem of underreported participation status is used. The difference-in-difference estimation pre/post-ARRA 2009 is applied to resolve the explanatory variable's endogeneity bias to deal with the second challenge. Third, the access to restricted NLSY79, a panel of 12,686 individuals, allows to follow the same individuals over more than 20 years and track their BMI changes over time. Furthermore, due to working with restricted data, a state fixed effect is added to the model along with the year and individual fixed effects. Fourth, the quantile regression is estimated to find the pattern of BMI changes across the whole sample, which has not previously been evaluated in most studies.

ARRA-related SNAP-benefits expansion acting as an income shock provided us with a great opportunity to track the changes in the individuals' BMI through an exogenous increase in their income. In this study, we follow the works of Waehrer et al. [2015], and Nord and Prell [2011] to analyze the causal effect of SNAP on BMI of low-educated SNAP-eligible individuals pre/post ARRA. Ten waves of the National Longitudinal Survey of Youth 1979 (NLSY79) are applied in this study to track the same individuals pre and post-ARRA. With this dataset and a difference-in-difference model for pre-post ARRA, it would be feasible to find the mentioned causal effect.

Consistent with the literature, this research finds that the BMI of SNAP-eligible individuals increased by 0.51 units after ARRA compare to nearly SNAP-eligible people, which is about 1.77% rise in the average BMI of this group. The quantile model's results indicate that people with BMI in higher quantile pre-ARRA had significantly higher BMI after SNAP expansion; however, this effect is different for individuals with an incompatible pattern of BMI pre-ARRA. These results are in accord with the findings of the recent study of Waehrer et al. [2015] indicating that the pre-ARRA pattern of dietary intake will affect post-ARRA changes significantly.

The next section describes a background on obesity and SNAP concerning the requirements of SNAP eligibility. Related works and dataset are discussed in sections 3 and 4, respectively. In section 5, this work's methodology is precisely described, and the results are stated in section 6. Finally, Section 7 concludes the paper.

1.2 Background

1.2.1 Obesity

Body Mass Index (BMI) is a beneficial measurement for determining if someone is overweight or obese. According to the Centers for Disease Control and Prevention (CDC), BMI is measured by dividing each person's weight in kilogram over the square of height in meters. Any BMI equals or higher than 25, but less than 30 is considered overweight. A BMI equals and higher than 30 is defined as obese, and if the number is beyond 40 is extreme or severe obesity.

The two most significant reasons that lead to obesity are people's behavior and genetics. Dietary habits, amount of exercise, medication use, and lifestyle are a few examples of behaviors that affect BMI. The role of genetics in BMI is undeniable. Genetics influence an individual's height and the number of calories a person can consume in a day. We cannot modify individuals' genetics, but we can educate them to change their behaviors toward healthier eating habits, regular exercise, and a healthy lifestyle in general. As a result, the whole nation would be healthier with a lower chance of obesity-related diseases.

Obesity affects not alone individuals' health but also the U.S. health care system and the whole economy. Problems associated with obesity will increase direct medical and indirect non-medical costs. The vast sum of money that people pay for preventive, diagnostic, and treatment services as direct costs is not the only cost that society incurs. The indirect cost of obesity is also significant. Indirect costs related to morbidity, mortality, and the decreasing rate of workers' productivity are enormous.

Trogdon et al. [2008] reviewed 31 works published from 1992 to 2008 on the indirect costs of obesity. They show that the number of days that obese workers are absent in their work due to an ailment, injury, and disability are significantly higher than non-obese workers. It was determined that the annual nationwide consequences to society from the decrease in workers' productivity are between \$3.38 billion (\$79 per obese individual) and \$6.38 billion (\$132 per obese individual).

Obesity in the U.S. has become a crucial issue over the past few decades. According to the National Center for Health Statistics (NCHS), Figure 1.1, the number of obese adults increased by 39.6% from 2015 to 2016. Although the high growth rate of obesity is evident in all age ranges, this rate varies among different age groups. Young adults aged between 20 to 39 had the lowest growth rate of obesity (35.7%). The highest growth rate of obesity was 42.8%, which was identified among middle-aged groups (40-59), and 41% for adults older than 60. The interesting observation is that the increased rate of obesity is higher among women than men in all age groups; however, this difference is more significant among people younger than 60. Looking at the other data source provided by the CDC in the previous years, an increase in obesity among adults and youth from 1999 to 2014 is noticeable.

Beside the different mentioned factors that cause higher BMI, some other reasons lead to having more obese people in the U.S. There are various government-related programs for assisting poor people to buy food. Some believe that these kinds of food-assisting programs might cause a higher rate of BMI in society. Supplemental Nutrition Assistance Program (SNAP) and Women, Infants, and Children (WIC) are the two largest programs in the U.S. to prevent low-income families from hunger.

1.2.2 Supplemental Nutrition Assistance Program (SNAP)

1.2.2.1 The History of SNAP

The most extensive government food-assistance program in the U.S. is the Supplemental Nutrition Assistance Program (formerly called the Food Stamp Program). The SNAP was introduced in 1933 and was a part of the Agricultural Adjustment Act (AAA). It was created in the middle of the Great Depression to diminish crop surplus's negative results for farmers. In 1939, Henry Wallace, the Secretary of Agriculture, institutionalized this program in the United States and named it the Food Stamp Program. This food assistance program was only accessible to low-income families during that time.

Between 1988 and 1990, the Electronic Benefit Transfer (EBT) card was proposed to integrate the Food Stamp Program administration and make using this benefit more convenient for its participants. The Food Stamp Program's name changed to the Supplemental Nutrition Assistance Program (SNAP) with the 2008 Farm Bill.

In 2016, the SNAP program was the most significant federal food assistance program in the U.S. and served more than 44 million Americans (FSP). Many studies have been examining the effects of SNAP on poor people's health determinants convincing the government to improve this program's regulations. For instance, excluding unhealthy products from the SNAP-qualified food list (like sugar-sweetened beverages).

President Obama signed Farm Bill on February 7, 2014, which significantly modified this program. Based on the new changes, some specific items excluded from the list of qualified items, such as alcoholic beverages, tobacco products, and restaurants (FNS).

1.2.2.2 The Eligibility for SNAP

Income: In order to be eligible for all types of the government food assistance programs like SNAP, some specific requirements have to be met. Income is the primary requirement that people have to meet for SNAP eligibility. A person could receive SNAP benefits if his/her household's income is lower than a specific threshold, which varies with each household size level. Both gross and net household income is required for determining SNAP-eligibility. Table 1.1 shows the income thresholds for different household sizes.

If someone's household is gaining an income above these limits, they would not be allowed to participate in the SNAP[1]. The government determines thresholds for receiving SNAP benefits yearly. Federal Poverty Thresholds are different for each household sizes (Table 1.2). As will be explained in section 5, this table is used to determine eligible people in this study.

[1]Gross income means a household's income before any deductions, and net income means their income after allowable deductions.

Resources: The asset is another determinant of SNAP-eligibility. Assets generally are resources like bank accounts, which are readily available for buying food. Any family with $2,250 or less in their accountable resources can be considered eligible for participation; however, their assets could be as high as $3,500 if there is a disabled or older than 60 years old person in the household (FNS).

Employment Requirements: Another condition that should be satisfied for being eligible for the SNAP program is the work requirement. People have to be registered for work, and they are not allowed to reject a job opportunity without a logical reason. Moreover, if they quit their job or choose to work fewer hours voluntarily, they will no longer be eligible for SNAP. Children, seniors, pregnant women, and physically or mentally disabled people do not need to meet these requirements.

Benefits: The amount of money that individuals receive as SNAP assistance is called an allotment. The amount of monthly allotment is calculated based on households' net income and household sizes. First of all, households' monthly income is multiplied by 0.3. This number is subtracted from the maximum allotment for that specific level of household size. The remaining number shows the acceptable SNAP allotment for that household. The maximum monthly allotments for each level of household sizes are provided in Table 1.3. As it is mentioned on the Food and Nutrition Service's website, "*SNAP benefits are available to all eligible households regardless of race, sex, religious creed, national origin, or political beliefs*" (FSP).

The amount of benefit or allotment for SNAP recipients increased temporarily with ARRA 2009. Table 1.3 shows the change in maximum allotment for households pre-ARRA, during ARRA, and after its expiration. Due to SNAP benefits expansion, people had more incentives to participate in the program during the years that ARRA was effective. Since receiving more allotment could cover all the costs related to register and participate in the SNAP, which may not be attractive enough for some SNAP-eligible individuals pre-ARRA.

1.2.3 American Recovery and Reinvestment Act of 2009 (ARRA)

The great recession of 2007 - 2009 made a challenging economic situation for the majority of Americans. The unemployment rate went up because of the recession, and households' income and spending money on food purchasing decreased substantially (Kumcu and Kaufman [2011]). To alleviate the hardship caused by this recession, ARRA 2009 was enacted and signed by President Obama in February 2009. The principal targets of ARRA were creating jobs and boosting economic standards. The benefits of this act became available in 2009 and expired at the end of 2013.

One of this act's main channels for correcting adverse economic conditions was through SNAP. The ARRA 2009 increased the amount of the allotment for SNAP recipients by a constant dollar amount for each household size. Although the percentage rise in benefits was different for each income level, the median value of SNAP benefits went up about 17%. Furthermore, some eligibility rules were relaxed by this act; for instance, unemployed childless adults became eligible for SNAP during the years that ARRA was effective. Based on USDA's data, SNAP enrollment expanded by 53% from 2007 to 2010, and the number of recipients reached its peak in 2013 with about 47 million registrants (FNS).

1.3 Literature Review

The reduced form models have been the most common research method employed in studying the relationship between BMI and health. When it comes to SNAP, the link between program participation and the probability of being more obese has got the most attention. Townsend et al. [2001] claim that being a SNAP participant leads to a 38% higher risk of obesity. A cross-sectional Logit model was used to control demographics, food insecurity, exercise, and TV watching. Since then, many researchers have studied this causal effect; however, most papers show a lower effect of SNAP participation on being overweight among women and almost no effect among men.

Gibson [2003] and Baum [2011] in their papers employed fixed effects linear regression models to account for individuals' time-invariant unobserved characteristics to analyze the effects of SNAP on obesity. Gibson's results show that the rise in obesity is as low as 9.1% among women, while Baum's finds a 13.5% increase. Also, they observed that being in the SNAP program for two years inflates this rate by 25%.

In order to find the outcomes of SNAP participation on obesity or BMI, we face two main challenges; endogenous selection into participation and systematic underreporting of participation status (Kreider et al. [2012]). For solving the endogeneity problem, some researchers employed the food stamp policies as instruments in panel data. Meyerhoefer and Pylypchuk [2008] show that women participating in the SNAP program are less likely to have a normal weight by 5.9% and more likely to be obese by 6.7%. Their results are compatible with Baum [2007] which shows a positive influence of SNAP participation on being overweight among women. Both works are done by the same method for identification, which was state-level policy instruments.

Kaushal [2007] uses the 1996 Personal Responsibility and Work Opportunity Reconciliation Act (PRWORA) as an Instrumental Variable to evaluate the causal effect of SNAP participation on BMI. He investigated the changes in BMI of low-educated unmarried immigrant women before and after this act, making many SNAP-eligible immigrants unqualified for this benefit. He finds a small 0.3% increase in people's BMI, which was statistically insignificant. Fan [2010] shows almost the same result by a difference-in-difference model. He identifies a little evidence for SNAP's impact on obesity and low-income women's body mass index.

Recent studies mostly show almost no causal effect of SNAP participation on higher BMI among men and a minimal effect amongst women. Nevertheless, the results are different when it comes to children's obesity. For example, Gibson [2004] uses fixed-effects linear regression to identify the connection between SNAP participation and BMI among girls and boys between 5 to 11 years old. He finds that the girls participating in the SNAP program for at least five consecutive years would be more obese by 42.8%; however, this impact is not the same among boys. The same-aged boys are 28.8% less obese if participating in SNAP. Also, SNAP benefits did not affect older boys and girls.

Gibson [2006] continued his work and showed in another paper that SNAP's effect on being overweight, was shown in his previous paper, was only seen in families that both mothers and daughters were overweight. Schmeiser [2012] used Earned Income Tax Credit and state-level SNAP eligibility rule as an IV and the same dataset that Gibson [2006] used. He found different results, presenting the SNAP program will decrease the chance of being overweight among 5 - 18-year-old boys and 5 - 11-year-old girls. The decrease in this probability is even higher among girls than boys.

The extensive systematic underreporting of participation status still remains a primary problem in considering SNAP participation's causal effect on BMI. Waehrer et al. [2015] followed Nord and Prell [2011] approach to examine the effect of SNAP on dietary intake of low-income individuals for pre and post ARRA 2009. They used the 2009-2010 NHANES data set to find the effects of an increase in the SNAP benefits on diet quality of SNAP-eligible compared to SNAP-ineligible ones. They find that a higher SNAP benefit level does not influence diet quality in the full sample; however, it caused a reduction in diet quality for low-educated individuals. They also show that people with different pre-ARRA diet quality pattern would have a different post-ARRA dietary intakes. Therefore the effects of SNAP on dietary intakes are not the same across the sample of SNAP-eligible individuals.

The SNAP participation rate among SNAP-eligible people is available on the USDA website. For instance, in 2014, among 51 million SNAP-eligible people, approximately 42 million registered for the benefits; the participation rate among eligible people was about 83%. In 2016, the number of eligible ones was 47 million, and 40 million were registered for SNAP; about 85% SNAP participation rate.

As a result, there is always a high SNAP-participation rate amongst SNAP-eligible groups; however, the rate of self-reported SNAP participation in different surveys has always been reported much lower than this number. Several reasons can explain this difference in real and self-reported SNAP participation rate. However, the most important reason can be the perceived social stigma associated with government assistance program participation. The underreporting participation status is a primary challenge in studies on all government assistance programs (Colby et al. [2016]).

In this work, to deal with the two mentioned huge problems of endogeneity and underreporting participation status, the approach of Waehrer et al. [2015] is being followed. This study's main target is finding the causal effect of the ARRA-related increase in the SNAP-benefits on the SNAP-eligibles' BMI compared with nearly SNAP-eligible individuals. Changes in People's BMI pre and post-ARRA allow us to use a difference-in-difference model. The SNAP-eligibility is used in this study as an index for defining the SNAP-eligible individuals in our dataset. Employing SNAP-eligible people instead of SNAP-participants (self-reported participation) can help us overcome the underreported SNAP-participation problem.

1.4 Data

1.4.1 NLSY79

We examine restricted data from the 1996 to 2014 National Longitudinal Surveys of Youth 1979 (NLSY79), which is a part of the National Longitudinal Surveys (NLS) program. The U.S. Bureau of Labor Statistics has been conducting this survey since 1979, a nationally representative sample of 12,686 individuals residing in the U.S. The questionnaires were filled by respondents annually up to 1994 and biennially since then. The respondents aged from 14 to 22 years old at the starting year of the survey.

The gathered information from respondents are being categorized in different groups, including; 1) Household, Geography, and Contextual Variables 2) Dating, Marriage, and Cohabitation 3) Sexual Activity, Pregnancy, and Fertility 4) Income, Assets and Program Participation 5) Health 6) Crime and Substance Use 7) Survey Methodology 8) Education, Training, and Achievement Scores 9) Employment 10) Children 11) Parents, Family Process and Childhood 12) Attitudes, Expectations, and Non-cognitive Tests.

NLSY79 has several enticing aspects for this study. First, due to this dataset's longitudinal framework, we can track the same individuals and observe their BMI changes over time. Second, this dataset has all information about respondents' demographic and socioeconomic characteristics that affect BMI. Third, this dataset's last wave is in 2014, which provides us with information about individuals' BMI and is a long enough period after ARRA 2009. As a result, it enables us to capture respondents' BMI changes due to an increase in ARRA-related SNAP expansion. Finally, In the NLSY79, all the information about net household income is available, the primary SNAP eligibility indicator.

1.4.2 Summary Statistics

This paper is constructed based on the restricted data of NLSY79. Table 1.4 presents the percentage of obese ($BMI \geq 30$), overweight ($25 \leq BMI < 30$), normal ($18.5 \leq BMI < 25$) , underweight ($BMI < 18.5$), and fat (obese and overweight together) respondents in 2 different categories. SNAP-eligible individuals have a household income lower than 100% of Federal Poverty Level (FPL) in both 2008 and 2012, and SNAP-ineligible (nearly-eligible) households have an income between 100% and 250% of FPL in the same two years. These people can be described as individuals with long-term SNAP eligibility and long-term SNAP ineligibility, respectively.

Table 1.4 display different characteristics of these two groups in the year 2008 and 2012. This table shows that the percentage of obese people increased among both SNAP-eligible and ineligible groups pre/post-ARRA; however, this rise is higher among the eligible groups. Although the percentage of overweight people decreased within the eligible group, this number increased slightly among ineligible ones.

Individuals are categorized into two groups, SNAP-eligible and SNAP-ineligible. The index for eligibility will be explained in more detail in the next section. Table 1.5 presents different characteristics (weighted means) of NLSY79 respondents from 1996 to 2014 in 2 groups, SNAP-eligible, and SNAP-ineligible (nearly SNAP-eligible) ones, in the year 2008 (1 year before ARRA 2009) and 2012 (3 years after ARRA was started).

According to data, 39% of SNAP-eligible respondents participated in SNAP in 2008; however, it is more accurate to say that only 39% reported their participation. During ARRA in 2012, this number increased to 50%. BMI's mean of the eligible group increased from 29.14 to 29.54, while this rise was from 29 to 29.37 among the ineligible people. The percentage of single SNAP-eligible respondents are much higher than SNAP-ineligible ones. SNAP-eligible people are mostly black compared to the near SNAP-ineligible group. The percentage of SNAP-eligible people with a grade lower than high school is higher than ineligible ones, the same pattern for their parents' education. In this study, everyone with an education higher than high school and all pregnant women is dropped from the sample. [2]

Figure 1.2 shows the trend of BMI from 1996 to 2014 for three different groups, full sample or low-educated people (with a degree of high school or lower), SNAP-eligible (treatment group), and SNAP-ineligible (control group) adults. Amongst respondents of NLSY79, those who are SNAP-eligible have a higher rate of BMI during all years. SNAP-ineligible respondents always had a lower mean of BMI than eligible ones; however, their BMI's mean is above the full sample in all years. Furthermore, the trend shows that mean of BMI increased for all three groups during these years. This trend proves again that BMI in the U.S. is increasing. So this growing rate of BMI is turning into a severe issue, and the government needs to take action to solve this problem.

[2]The weight of a pregnant woman is not the right measurement for finding her BMI.

1.5 Empirical Strategy

Self-selection bias is the most challenging issue in finding the SNAP's causal effect on participants' BMI. The SNAP participants might have some unobserved characteristics that correlate with their BMI. For instance, SNAP participants might pay less (more) attention to nutrition facts while purchasing foods. As a result, they would have higher (lower) BMI even with the absence of SNAP. So we would end up overestimating (underestimating) this causal effect if we ignore this problem. The potential solution to deter this problem is considering changes in SNAP benefits made by ARRA2009 as a natural experiment. Pre-post ARRA2009 provides us with an exogenous increase in SNAP benefits, unrelated to individuals' unobserved characteristics affecting BMI.

To observe the actual effects of ARRA-related increase in SNAP-benefits on people's BMI, the same individuals need to be tracked. In their studies, Waehrer et al. [2015] and Nord and Prell [2011] were concerned about the different characteristics of SNAP participants pre-post ARRA affecting their BMI. ARRA made an excellent incentive for participating in the SNAP by increasing its benefits and relaxing some requirements. Due to all the costs related to applying for the SNAP, some eligible people who were not willing to participate in this program pre-ARRA might be enticed to register during the ARRA.

On the other hand, the Great Recession of 2008-09 made many people unemployed or eligible for SNAP. So there was a new flow of SNAP-eligible people requesting SNAP benefits. Although these people are SNAP-eligible now, they might have different characteristics and lifestyles than pre-ARRA eligible ones. Therefore, the authors claim that estimating the effects of ARRA on all SNAP-recipients during ARRA might bring us a biased estimation.

Table 1.6 shows the number of SNAP-eligible and ineligible individuals pre-post ARRA. The number of SNAP-eligible people increased from 817 in 2008 (before ARRA) to 1,242 in 2012 (after ARRA). These numbers prove that the concern of Waehrer et al. and Nord and Prell about an influx of new SNAP-eligible people by ARRA was correct.

In this study, the approach of Waehrer et al. [2015] is followed. In our estimation, the difference-in-difference model was applied to find the changes in SNAP-eligible individuals' BMI (instead of SNAP participants) compared to SNAP-ineligible ones (instead of SNAP non-participants) pre-post ARRA. The main requirement for SNAP-eligibility is households' net income. Anyone with a household income just greater than 100% of federal poverty thresholds could be eligible for SNAP. In the NLSY79 data set, all respondents' net household income is provided.

Waehrer et al. [2015] used the following criteria for finding SNAP-eligible and ineligible people: Each person with a household's income equal or lower than 100% of FPL is considered SNAP-eligible. Each person with a household's income above 100% and below 250% of FPL is called SNAP-ineligible (collected from NHANES in 2009), or as Nord and Prell [2011] named "nearly SNAP-eligible households".

Although SNAP-ineligible households are less economically stable than eligible ones; they are considered eligible for some public health insurance programs. For instance, the threshold for finding Medicaid-eligible and the Children's Health Insurance Program-eligible people in most states is determined by an income lower than 250% of FPL. So, these group is not eligible for SNAP benefits; however, most of them are not economically secure. It means that they are low-income households and can be used as a fair comparison group for SNAP-eligible ones regarding their socioeconomic characteristics.

This method would solve the substantial problem of systematic underreporting participation status, which is the main challenge of finding the causal effect of assistance programs on the economic or health determinants. Using the intent-to-treat effect (SNAP-eligibility instead of SNAP-participation) would reduce the stated problem's negative effect.

In this study, to deal with the specified concerns about new SNAP-eligible people post-ARRA (Waehrer et al. [2015] and Nord and Prell [2011]), eligibility criteria is modified as follows: Households with an income equal or lower than 100% of FPL in both 2008 and 2012 are considered SNAP-eligible. The year 2008 is one year before the starting year of ARRA, and 2012 is three years after ARRA's start date. Eligibility in these two years was selected to ensure that SNAP-eligible households in the sample are low-income even before ARRA, and events like the Great Depression did not make them SNAP- eligible.

By using these criteria, tracking the same people over time with long-term SNAP-eligibility and more economic insecurity is becoming possible. With the same logic, SNAP-ineligible households are people who have an income higher than 100% of FPL but just lower than 250% of FPL in both years of 2008 and 2012. Based on the mentioned framework, the number of SNAP-eligible and ineligible households are determined in Table 1.6. The total number of SNAP-eligible and SNAP-ineligible individuals in this study are 714 and 475 people. Equation 1.1 is estimated to find the primary question of this research:

$$BMI_{its} = \alpha + \beta X_{its} + \gamma ARRA_t + \delta ELIG_{its} + \theta ELIG_{its} * ARRA_t + \omega_i + \lambda_t \mu_s + \epsilon_{its} \tag{1.1}$$

Where the dependent variable is Body Mass Index (BMI is calculated by dividing the weight in kilograms by square of height in meters). BMI_{its} shows individual i living in year t in the state s. In the analysis, the variable X_{its} is added to the model to control for respondents' characteristics such as age, household size, marital status, highest degree completed, urban, etc. ω_i is added to the model to control for individuals' unobserved characteristics. Variable $\lambda_t \mu_s$ controls for interactions of year and state fixed effects, which latter are only available in the confidential NLSY79.

Survey respondents' age is between 14 and 22 years old in 1979 (the starting year of the survey) and between 31 and 57 years old in the last year of this study. All respondents with a degree higher than a high school diploma were eliminated from the sample to have more similar eligible and ineligible groups. Individuals in SNAP-eligible and ineligible groups were tested to make sure there is no pre-trend in their

BMI, and no trend was found in ten waves of applied data in this study.

Variable $ARRA_{its}$ is an indicator for the years after ARRA 2009, and $ELIG_{its}$ shows the eligible individuals based on the criteria explained before. Therefore, θ estimates the effect of the ARRA-related increase in SNAP-benefits after 2009. The equation 1.1 is estimated with both OLS and Fixed Effect models to control for individuals' unobserved characteristics. Quantile regression is also estimated to show the heterogeneous response to increased SNAP-benefits and its different potential effects on BMI. It also lessens the effect of outliers.

1.6 Results

This paper's main findings are explained in this section: The results from estimating the effects of SNAP participation on BMI, the causal impact of ARRA2009 on the BMI of SNAP-eligibles (intent-to-treat effect) with OLS and FE models, quantile regression, together with robustness checks.

1.6.1 The Effect of SNAP Participation on BMI with OLS and Fixed Effect Models

Table 1.7 reports estimates of BMI changes among SNAP participants and SNAP-eligible individuals after starting ARRA, with OLS and Fixed Effect models, including individual, year, and state fixed effects. The individual fixed effect is added to the model to control for individuals' unobserved characteristics. The year and state fixed effects are also included in this estimation to control for government programs, policies, and other trends that might take place in those years or specific states. Ten waves of the NLSY79 data set is used in this estimation, and all individuals are aged between 37 and 57 years old from 1996 to 2014 with education just lower than high school.

The first column of Table 1.7 shows a naive OLS regression of BMI on SNAP participation. The coefficient shows 1.42 units higher BMI among the program's participants after receiving more benefits from

ARRA. In column 2, all socioeconomic variables are added to the model, for example, age, region, urban, race, parents' education, and family structure. The result shows a positive and significant coefficient in a 99% confidence interval. This number suggests a 3.6% increase in the average BMI of SNAP-participants.

There are individuals' unobserved characteristics that OLS cannot control, but they might correlate with BMI. Therefore the difference-in-difference estimation was applied in the last three columns of Table 1.7. The coefficient in column 4 shows a positive and significant increase in SNAP-participants' BMI with a FE model. These results are consistent with the previous studies such as Gibson [2003], Zagorsky and Smith [2009], Townsend et al. [2001], and Chen et al. [2005]. All of these studies found a higher BMI among SNAP-participants.

The coefficient found by FE (0.3) after controlling for socioeconomic indicators is substantially lower in comparison with OLS (1.04), which means a high part of that rise was due to unobserved characteristics that affect BMI. It indicates that using OLS is subject to omitted variable bias and fixed effects model is preferred.

1.6.2 Intention-To-Treat Analysis with Difference-In-Difference Estimation

In the next step, the SNAP-participation was replaced by SNAP-eligibility to solve the substantial problem of underreporting participation status. The criteria for determining eligibility and ineligibility was described in detail in section 1.5. The primary independent variable estimated by difference-in-difference estimation, the SNAP-ELIG*ARRA (θ in the equation 1.1), is provided in columns 3 and 6 of Table 1.7. This coefficient shows the effect of an increase in SNAP-benefits by ARRA2009 on the BMI of long-term SNAP-eligible individuals compared to SNAP-ineligible ones pre post-ARRA.

By controlling for all socioeconomic indicators and applying the year and state fixed effect, the sample size decreased to 4,900 individuals. The estimated θ by OLS in column 3 indicates an increase in

BMI of SNAP-eligible people by 0.4 units compared to ineligible ones after ARRA, which is statistically significant with a confidence interval of 90%.

The individual fixed effect estimation was applied to control the individuals' characteristics that do not vary over time (such as the initial health endowment). This estimation is the most crucial estimation of this study. In this part, the SNAP-eligibility is used instead of SNAP participation, and also individual, year, and state fixed effect are applied in the estimation. The Difference-in-difference model with FE estimation indicates that the boost in SNAP benefits by ARRA positively impacted SNAP-eligible people's BMI. Its results are shown in column 6 of this table. The estimated θ shows a positive and statistically significant increase in BMI of SNAP-eligible people after ARRA by 0.51 compared with SNAP-ineligible people before ARRA.

This estimation's results indicate that a person who was eligible for SNAP gained more BMI than an ineligible person by 0.51 unit, that is about a 1.77% rise in the average BMI of the eligible group. All SNAP-eligible people in this study sample are low-educated with household income just lower than 100% of FPL in both 2008 and 2012. Therefore, all have long-term SNAP-eligibility and are highly sensitive to income shocks, such as ARRA-related SNAP changes.

1.6.3 Quantile Regression

The results explained in the previous section show a negative effect of ARRA on the SNAP-eligible individuals' health; however, it is critical to answering the following questions before jumping to the conclusion; Whether all SNAP-eligible people's BMI increased by ARRA? Whether all SNAP-eligible individuals with different BMI patterns pre-ARRA reacted the same to the SNAP-benefit expansion? Is there a group of individuals who improved their health after the ARRA-related raise in SNAP-benefits?

To answer the mentioned questions, quantile regression was applied. With quantile regression, SNAP-expansion's causal effect on BMI at the median, 25th, 75th, etc., are estimated. Although the previous results show that after ARRA, SNAP-eligible people are gaining more BMI due to an increase in SNAP benefits, the results from quantile regression show a different trend. The results from quantile regression in Table 1.8 show an interesting and different portrait of changes across the whole sample.

Changes in People's BMI in the lower percentiles show a different pattern than higher percentiles. Although the SNAP-ELIG*ARRA coefficient for this group is negative and statistically insignificant, these numbers are significantly different than the FE coefficient are shown in Table 1.7. The negative and small numbers indicate that SNAP-eligible ones in just below the 40th percentile pre-ARRA reacted differently to the ARRA-related SNAP expansion. Their BMI is getting smaller after ARRA, which is a reverse trend compared with the previous study results.

The corresponding BMI ranges are provided in the last two columns of Table 1.8. It indicates that individuals with a BMI of just higher than 25 are losing BMI by receiving more ARRA-benefits. These people are on the threshold of going from the normal to the overweight group. The findings suggest that these individuals are able to live healthier with ARRA-related SNAP expansion. Therefore, gaining more money for this group resulted in a lower BMI and being healthier. The majority of these individuals have the following characteristics; about 48 years old, males, one or two household-size, married, non-black and non-Hispanic, and living in the urban area.

People at the median of BMI range have a higher BMI by 0.96 units after ARRA establishment. These individuals' BMI is approximately 27, who are in the overweight group. As we increase the percentiles, the coefficient is getting larger. All numbers are statistically significant in the 99% confidence interval and significantly different than FE results. For example, the coefficient in the 90th percentile is as high as 1.17, showing a 4.05% increase in the people's average BMI in this group. Individuals in this category range from just below the obese to very obese (their BMIs range from 29.95 to 36.58).

The results from quantile regression indicate that even though ARRA-related SNAP-expansion caused a higher BMI for the SNAP-eligible group, its effect is not the same for everyone. Although obese and overweight people closer to obese were gaining more BMI after SNAP expansion, normal people and overweight closer to normal weight are losing BMI. These findings suggest that not everyone in this sample reacted to the SNAP-benefits rise in the same way. People with lower BMI changed their behavior and maybe started to eat healthier; however, overweight or obese people bought more unhealthy food and became more obese. Therefore, we cannot conclude that higher SNAP benefits negatively affected everyone!

1.6.4 Robustness Check

In this section, the sensitivity of the estimations to the SNAP-eligible and SNAP-ineligible thresholds are tested. Furthermore, whether the obtained results are robust to various specifications will be verified. The results for robustness check are provided in Table 1.9.

First, the coefficient of SNAP-EIG*ARRA (θ) from main DD estimation with an individual, state, and year FE is compared with OLS estimation. Its coefficient is 0.4, and it is statistically significant with a 90% confidence interval, which is not that different from our main coefficient (0.51**). Also, the primary FE model was estimated again without state and year fixed effects, and the results were similar in magnitude and significance (results not shown).

Second, to check the sensitivity of our results to SNAP-eligible and ineligible thresholds, the determinants of eligibility are changed. In model (1), the threshold of SNAP-eligibility increased from 100% of FPL to 130%. Also, SNAP-ineligibility thresholds changed from between 100% and 250% of FPL to between 130% and 300% of FPL; however, they still have to meet the requirements in both years 2008 and 2012. The coefficient is provided in the first column of Table 1.9 which is slightly smaller in magnitude but similar in being significant. It is smaller since the individuals in this sample are slightly more economically secure than the primary model.

Third, in the model (2), we keep the same thresholds; however, short-term eligibility is considered. People who meet the eligibility and ineligibility requirements in 2008 will be included in the sample. The year 2008 is one year before the ARRA and the beginning of the recession, so it can be valid to assume that they have been in the eligible group since years ago and have similar characteristics to the primary sample. The coefficient from this model is provided in column 2 of Table 1.9. The number is almost the same as the leading coefficient, which proves our assumption.

Forth, the same thresholds of the primary model are applied in the model (3); however, the requirements have to be met only in 2012 (three years after ARRA establishment). 2012 is a few years after the great recession, and many new people might be unemployed and included in the eligible group. Also, as ARRA relaxes some eligibility rules, new people became eligible for SNAP. Statistically speaking, according to the USDA website, the SNAP participation rate reached its peak during ARRA. Also, as shown in Table 1.6, the number of eligible people increased from 817 in 2008 to 1,242 in 2012. Therefore, new people were added to the SNAP-eligible group and changed the pattern of the sample. These new eligible people might have different characteristics, lifestyle, and eating habits than the long-term eligible people and may not be as sensitive to the income shocks. So as we expected, a smaller coefficient is found, presented in the third column of Table 1.9.

Fifth, in the model (4), we run the primary FE model with all the control variables excluding the household income. The result is shown in the fourth column. The coefficient is still similar in size and significance to the main result shown before. Also, as the sixth robustness check, the same model was run, including pregnant women or women who had recently given birth and found similar results (results not shown). Therefore, the findings of this study are robust to different specifications and not sensitive to eligibility thresholds.

1.7 Conclusion

In this study, the effect of ARRA-related SNAP-expansion on the BMI of SNAP-eligible individuals was examined. The ARRA2009 increased the SNAP benefits by 17% per person on average. It also relaxed some SNAP eligibility rules (Nord and Prell [2011]). Most studies such as Baum [2007] and Meyerhoefer and Pylypchuk [2008] used government policies as an instrument and found a positive effect of SNAP on BMI; however, Kaushal [2007] and Fan [2010] with a DD estimations, showed no causal effect of more benefits on SNAP-participants' BMI.

Recent studies like Nord and Prell [2011] used SNAP-eligibility instead of SNAP participation to lessen the unfavorable effect of underreported participation status. They found a reduction in people's diet quality and increased food expenditure after ARRA-related SNAP expansion.

Following their study, Waehrer et al. [2015] show that the decrease in diet quality of SNAP-eligible people is not consistent across the whole sample, and it is related to their pre-ARRA diet quality pattern. This discrepancy is more evident for people with insufficient nutrition and low diet quality before ARRA. Their work shows that low-educated people have potentially a more long-term SNAP eligibility and are placed in the lower 25th percentile of diet quality patten pre-ARRA. Their results show a higher mean caloric intake distribution among these people, meaning an inconsistent effect across the whole sample.

In this study, the causal effect of ARRA-related SNAP expansion on SNAP-eligible individuals' BMI with the DD model is examined. SNAP benefits expansion after ARRA might induce some people to register in the SNAP or make some eligible SNAP individuals. To prevent any changes in SNAP participants' composition pre-post ARRA, SNAP-eligibility in 2008 and 2012 was used to determine this study's sample. The results suggest a 1.77% increase in the BMI of low-educated people who had long-term SNAP eligibility compared to nearly SNAP-eligible people with ARRA.

This finding is consistent with the results of Waehrer et al. [2015] presenting lower diet quality and higher food expenditure among these people. Furthermore, quantile regression was applied to test the consistency of the results through the whole sample. The findings derived from this regression show different coefficients for various percentiles. The BMI of individuals located at the lower percentile of the BMI distribution reduced after receiving higher ARRA benefits; however, the BMI increased substantially among people with high BMI pre-ARRA.

These estimation results are also consistent with Waehrer et al.'s work and suggesting that the changes in people's BMI post-ARRA are significantly related to their pre-ARRA BMI pattern. Therefore, we can conclude that people with diverse BMI pre-ARRA do not react to the increase in SNAP benefits in the same way. There could be several explanations for these findings; First, some SNAP recipients could only buy their essential foods with SNAP allotment pre-ARRA. They had access to more money by ARRA and could buy more unhealthy foods and drinks, which they could not afford before.

Second, as Mancino and Guthrie [2014] mentioned in their work, the SNAP households are apt to purchase their food as little frequently as possible since they are not informed about Food Pyramid recommendations. Therefore, they buy less fresh vegetables and tend to buy more freezable meals. They also prefer to spend less time on food preparation. As a result, the more money they receive, the more unhealthy food they purchase.

Finally, As we conclude based on quantile regression, people with higher BMI react to this income shock differently. The possible explanation is based on one of the main principles of Economics; people respond to incentives! In different situations, people behave differently. Therefore, Overweight people close to normal weight thresholds might start purchasing food more wisely and try to live healthier; however, obese people respond to this new incentive (income shock) negatively. So they might need more education, more guides, and maybe stricter rules to spend their SNAP benefits.

Therefore, increasing the amount of money for SNAP recipients might not be enough to make them healthier or decrease their BMI. Providing people with clear and informative nutrition information while purchasing food, improving nutrition knowledge of the low-income and low-educated individuals, and structural enhancements in the food market will improve people's health in the whole nation.

1.8 Tables and Figures

Table 1.1: SNAP Gross and Net Income Thresholds in 2017

Household Size	**Gross monthly income** (130% of FPL)	**Net monthly income** (100% of FPL)
1	$1,307	$1,005
2	$1,760	$1,354
3	$2,213	$1,702
4	$2,665	$2,050
5	$3,118	$2,399
6	$3,571	$2,747
7	$4,024	$3,095
8	$4,477	$3,444
Each additional member	+453	+349

Notes: FPL = Federal Poverty Level

Table 1.2: Federal Poverty Level for Different Household Sizes

Federal Poverty Threshold	**HH-Size = 1**	**HH-Size = 2**	**HH-Size = 3**
2008	$10,400	$14,000	$17,600
2009	$10,830	$14,570	$18,310
2010	$10,830	$14,570	$18,310
2011	$10,890	$14,710	$18,530
2012	$11,170	$15,130	$19,090

Table 1.3: Maximum Monthly SNAP Allotment Before and After ARRA2009

People in Household	**2008** (Before ARRA)	**2009** (During ARRA)	**2014** (After ARRA)
1	$162	$200	$ 189
2	$298	$ 367	$347
3	$426	$526	$497
4	$542	$668	$632
5	$643	$793	$750
6	$772	$952	$900
7	$853	$1,052	$995
8	$975	$1,202	$1,137
Each additional member	$122	$150	$142

Table 1.4: Percentage of Obese & Overweight Individuals in 2008 (1 Year Before ARRA) & 2012 (3 Years After ARRA)

BMI Category	**SNAP-eligible 2008**	**SNAP-ineligible 2008**	**SNAP-eligible 2012**	**SNAP-ineligible 2012**
Obese	35.76%	40%	40.14%	43.28%
Overweight	36.98%	28.63%	32.79%	29.55%
Normal	24.48%	26.57%	25.99%	25.64%
Underweight	0.7%	1.4%	0.7%	1.1%
Fat	72.75%	68.65%	72.93%	72.83%

Notes: Sample comprised of respondents from 1996 to 2014 with education lower than high school.
The SNAP-eligible group is individuals with a net household income lower than 100% of FPL in 2008 and 2012.
The SNAP-ineligible group is individuals with a net income lower than 250% FPL and higher than 100% of FPL in 2008 and 2012.
FPL = Federal Poverty Level

Table 1.5: Descriptive Analysis Low-educated Respondents of NLSY79 in 2008 and 2012

	SNAP-ELIG 2008		**SNAP-INELIG 2008**		**SNAP-ELIG 2012**		**SNAP-INELIG 2012**	
Variable Name	Mean	Std. Err.	Mean	Std. Err.	Mean	Std. Err.	Mean	Std. Err.
SNAP recipient	0.39		-		0.5		-	
Sex								
Male	0.44		0.48		0.44		0.48	
Female	0.56		0.52		0.56		0.52	
BMI	29.14	0.26	29.0	0.34	29.54	0.3	29.37	0.34
Marital Status								
Single	0.33		0.14		0.31		0.13	
Married	0.18		0.46		0.19		0.48	
Separated	0.49		0.4		0.5		0.39	
Grade	10.86	0.1	11.56	0.07	10.9	0.7	11.62	0.08
Urban	0.7		0.64		0.73		0.66	
Race								
Hispanic	0.11		0.10		0.11		0.10	
Black	0.36		0.15		0.36		0.15	
Non-black, Non-hispanic	0.53		0.75		0.53		0.75	
Parents' Education								
Father's education	9.28	0.17	9.8	0.21	9.28	0.17	9.8	0.21
Mother's education	9.69	0.12	10.28	0.15	9.69	0.12	10.28	0.15
Age	46.47	0.09	46.33	0.12	50.47	0.09	50.33	0.12
Income	6.67	0.26	31.21	0.68	11.41	0.52	38.25	1.08
Family size	2.43	0.07	2.93	0.9	2.36	0.06	2.55	0.07
Region								
South	0.52		0.4		0.52		0.4	
West	0.13		0.17		0.13		0.17	

Notes: Reported values are the means, weighted by the NLSY 1979 population weights.
Sample comprised of respondents from 1996 to 2014, with education lower than high school.
SNAP-ELIG indicates SNAP-eligible individuals, with a net HH-income lower than 100% of FPL in years 2008 & 2012.
SNAP-INELIG indicates ineligible individuals, with a net HH-income lower than 250% FPL and higher than 100% of FPL in both 2008 & 2012.
FPL = Federal Poverty Level

Table 1.6: Number of SNAP-eligible and SNAP-ineligible Individuals Pre/Post-ARRA

Number of Individuals	SNAP-eligible 2012	SNAP-ineligible 2012
SNAP-eligible 2008	714	103
SNAP-ineligible 2008	528	475

Table 1.7: Association Between SNAP Eligibility and Adults' BMI

Dependent Variable	**OLS**			**Fixed Effect**		
BMI	**SNAP Participation**		**DD estimation**	**SNAP Participation**		**DD estimation**
SNAP participation	1.42***	1.04***		0.33***	0.3***	
	(0.22)	(0.26)		(0.08)	(0.1)	
Female		-0.14	1.43***			
		(0.2)	(0.5)			
Household size		0.13**	0.1		0.002	-0.04
		(0.05)	(0.11)		(0.02)	(0.05)
Age		0.34***	0.49		0.18**	0.32
		(0.13)	(0.3)		(0.1)	(0.21)
Region(= South)		15.15***	-0.35		-2.97***	3.42
		(1.05)	(1.66)		(0.4)	(2.31)
Father's education		-0.06*	0.004			
		(0.03)	(0.08)			
SNAP-ELIG			0.09			
			(0.57)			
*SNAP-ELIG*ARRA*			0.4*			0.51**
			(0.3)			(0.25)
IndividualFE	NO	NO	NO	YES	YES	YES
Year&StateFE	NO	YES	YES	NO	YES	YES
Observations	41456	23354	4900	41456	23354	4900
R^2	0.005	0.06	0.13	0.001	0.12	0.18

Notes: Standard deviations are in parenthesis.
The sample comprised of respondents from 1996 to 2014, with education lower than high school.
The symbols ***(p < 0.01), **(p < 0.05), and *(p < 0.10) indicate significance levels.
Models also controlled for highest grade completed (high school or lower), age square, region, urban, race/ethnicity, net household income, parents' education, family structure (never married/married/separated), and individual, year and state fixed effects.

Table 1.8: Quantile Regression

Quantiles (Percentiles)	**Coefficients** (SD)	**Significantly Different than FE Coefficient (0.51**)**	**BMI Range**	
			Min	**Max**
25	-0.14 (0.22)	✓	24.07	24.22
40	-0.21 (0.3)	✓	25.81	25.82
50	0.96*** (0.14)	✓	27.09	27.25
70	0.95*** (0.21)	✓	29.76	30.03
90	1.17*** (0.3)	✓	29.95	36.58
95	1.2* (0.7)		36.32	40.99

Notes: Standard deviations are in parenthesis.
The symbols ***(p < 0.01), **(p < 0.05), and *(p < 0.10) indicate significance levels.
Symbol of ✓means the corresponding coefficient is statistically significantly different than the FE coefficient.

Table 1.9: Robustness Check

Dependent Variable	**(1)**	**(2)**	**(3)**	**(4)**
*SNAP-ELIG*ARRA*	0.39** (0.22)	0.43** (0.2)	0.2* (0.12)	0.4* (0.24)
IndividualFE	YES	YES	YES	YES
Year&StateFE	YES	YES	YES	YES

Notes: Standard deviations are in parenthesis.
The symbols ***(p < 0.01), **(p < 0.05), and *(p < 0.10) indicate significance levels.
(1) The SNAP-eligible people's threshold increased from households' net income lower than 100% to 130% of FPL in both 2008 and 2012. (2) Eligible people are determined by a net HH-income lower than 100% FPL only in the year 2008 (short-term eligibility). (3) Eligible people are determined by a net HH-income lower than 100% FPL only in 2012 (during ARRA, including new eligible people). (4) The same FE model is estimated, excluding income as an independent variable.
FPL = Federal Poverty Level

Table 1.10: Association Between SNAP Eligibility and Adults' BMI (Full Table)

Dependent Variable	**Individual Fixed Effect**		
BMI	**SNAP Participation**		**DD estimation**
SNAP participation	0.32***	0.3***	
	(0.08)	(0.1)	
Female			
Household size		0.002	-0.04
		(0.02)	(0.05)
Age		0.18**	0.32
		(0.1)	(0.21)
Age^2		-0.0008	-0.003
		(0.001)	(0.002)
Net household income		0.002*	0.004
		(0.001)	(0.003)
Race			
Black			
Non-black/non-hispanic			
Region			
North central		-1.47	-12.17***
		(0.99)	(3.4)
South		-2.97***	3.42
		(0.4)	(2.13)
West		2.92***	14.54***
		(0.45)	(3.02)
Urban		-0.04	-0.24
		(0.07)	(0.19)
Marital status			
Married		0.18	-0.06
		(0.2)	(0.4)
Separated		-0.4*	-0.42*
		(0.22)	(0.43)
Parents' education			
Father's education			
Mother's education			
SNAP-ELIG			
ARRA			
*SNAP-ELIG*ARRA*			0.51**
			(0.25)
Constant	28.65***	25.22***	16.85***
	(0.01)	2.36	(5.26)
IndividualFE	YES	YES	YES
Year&StateFE	NO	YES	YES
Observations	41456	23354	4900
R^2	0.001	0.17	0.18

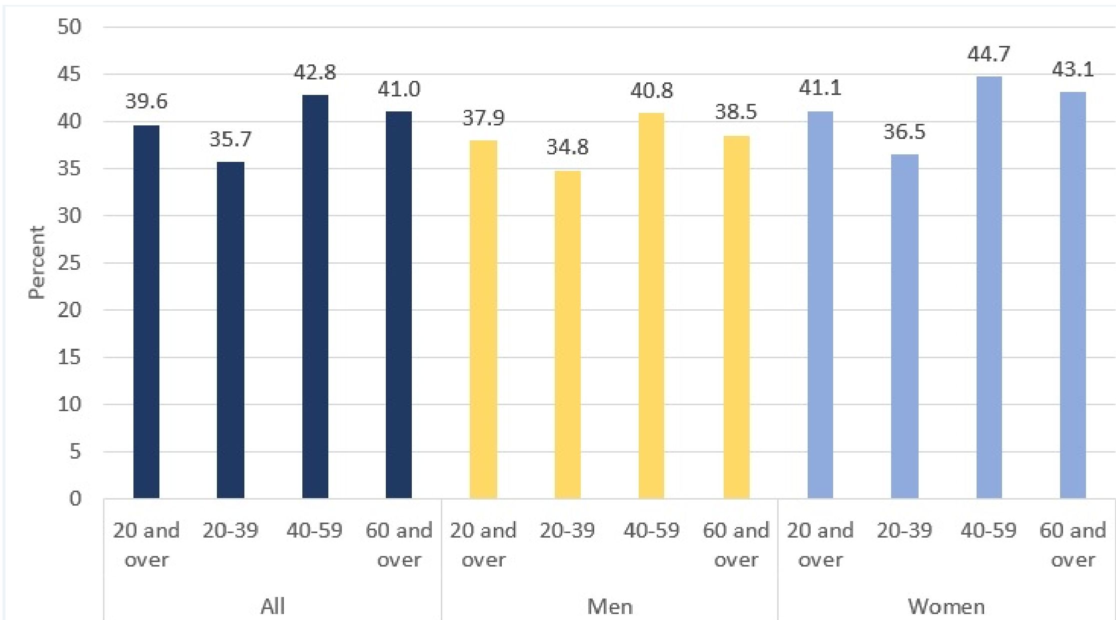


Figure 1.1: Prevalence of obesity among people older than 20 in the U.S. from 2015 to 2016

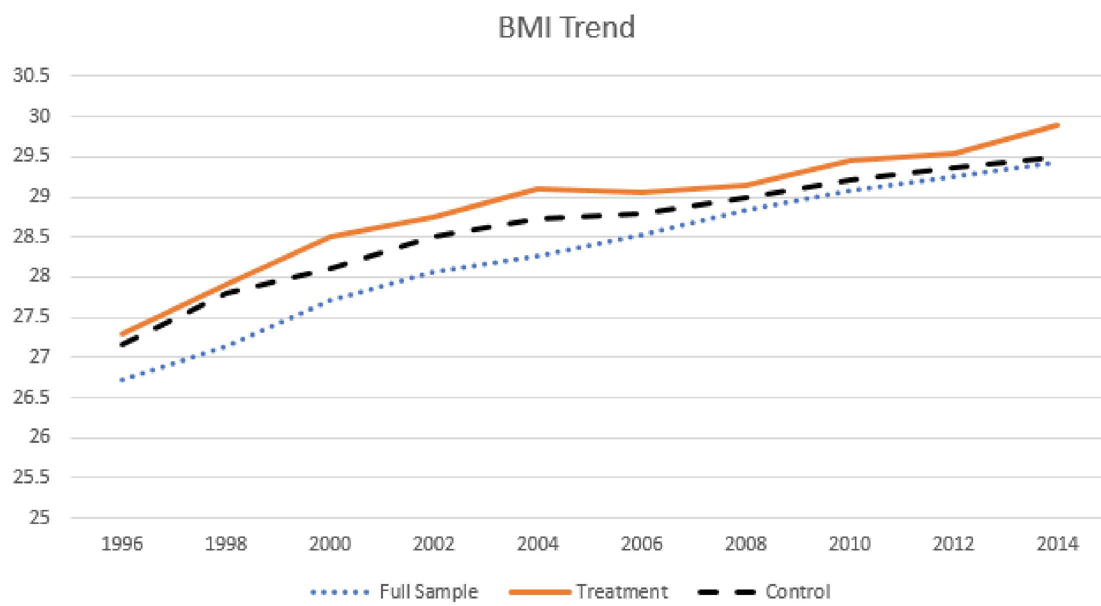


Figure 1.2: Prevalence of obesity among low-educated adults in the U.S. from 1996 to 2014.
Note: Treatment Group are SNAP-eligible, and Control Group are SNAP-ineligible individuals in NLSY79. The criteria for determining SNAP-eligible and ineligible people are explained in detail in section 1.5.

CHAPTER 2 : DO CHANGES IN THE NUTRITION FACTS LABELS AFFECT SNAP-PARTICIPANTS' FOOD PURCHASING DECISIONS? AN EXPERIMENTAL ANALYSIS

2.1 Introduction

Obesity is defined as a primary and growing health concern in the U.S. and worldwide. Wang et al. [2008] predicted that by 2030, over 85% of Americans and over 50% of U.S. adults would be overweight and obese, respectively. The leading cause of obesity is rooted in energy imbalance, meaning consuming more calories than we burn (Spiegelman and Flier [2001]). Most individuals claim that they care about eating healthy and nutrient-dense meals and snacks; however, many studies prove that Americans tend to eat excess calories, saturated fat, and sodium than the sufficient levels (Glanz et al. [1998] and Doll et al. [2009]).

According to the indicated results in chapter 1, the increased benefits of the Supplemental Nutrition Assistance Program (SNAP) by the American Recovery and Reinvestment Act of 2009 (ARRA) increased Body Mass Index (BMI) rates of SNAP-eligible adults. The findings of this study are consistent with the previous research in this area. For instance, Waehrer et al. [2015] observed a lower-quality diet and higher food expenditure among SNAP-eligible people receiving more benefits from ARRA. Therefore, low-income people's health, specifically the SNAP-recipients' health, is susceptible to their budget changes.

Several potential explanations for these findings are presented in the previous chapter. For instance, SNAP recipients were only able to purchase essential foods with SNAP allotment pre-ARRA. By receiving more money from ARRA, they might end up buying more unhealthy foods and drinks that they previously could not afford. Thus, having access to more money to purchase food increased SNAP-eligible individuals' BMI and made most of them unhealthier.

Consequently, improved SNAP beneficiaries' funds without nutrition information and health awareness could not be adequate to make them healthier or less obese. A brief summary of the critical recommendations suggested in chapter 1 are as follows: Training SNAP-participants and increasing the nutrition awareness among low-income consumers and providing straightforward nutritional information for low-income individuals while purchasing food items. This information should be informative and easy to comprehend, which requires the government to make structural improvements in the food market.

The first and most important step to encourage healthy food purchasing behavior is providing consumers with an excellent nutrition fact label's format that is explanatory and understandable by all consumers with a wide range of characteristics. Nutrition Facts Tables are able to assist people to make wiser and healthier food purchasing decisions. Many studies show a high correlation between food label use and a lower intake of calories, fat, sodium, and higher fiber intake (Kim et al. [2000]). Some recent studies suggest that consumers mostly disregard nutrition facts tables while shopping; however, they have difficulty grasping its information when paying attention to the food labels (Cowburn and Stockley [2005]).

Although there is a great body of literature in this area, recent studies, such as Cowburn and Stockley [2005], raised the following questions: Are current wording, format, and design of nutrition fact tables the most efficient way to convey nutrient information to consumers? Are they successful in grabbing shoppers' attention? Can food labels' differences catch more consumers' attention? Are they helping food label viewers to choose the most nutrient and healthiest food items?

This study will contribute to the existing literature by adding experimental research findings that simulate a real-world shopping experience. Using the advanced technological system helped us capture many vital features impossible to catch without the laboratory environment. Due to a great distributed sample of participants in terms of gender and education, this study's findings contributed significantly to the literature. Moreover, this experiment by targeting SNAP-recipients provides us with a great insight into their shopping behaviors, food purchasing decisions, and helps policymakers enact effective policies enhancing public health.

This research analyzes whether changes in the wording and design of the nutrition facts table introduced by the Food and Drug Administration (FDA) in 2016 (Figure 2.4) affect food label use among SNAP-recipient consumers. Furthermore, the effects of a change in the nutrition fact tables' location are estimated by showing two sets of slides with different food label placement to observers. The impact of viewing the nutrition fact table on consumers' healthy purchasing decisions is also estimated in a model with an instrumental variable.

This study's results show that SNAP-participants pay more attention to the nutrition fact tables when facing the new version of food labels suggested by the FDA in 2016. We also found that the nutrition table's location plays the primary role in catching consumers' attention. SNAP-participant consumers use the nutrition tables statistically significantly higher when the food labels are in the slides' center. Therefore, the wording, design, and location of the food labels matter. The results show that SNAP-recipient consumers who view the nutrition facts table while purchasing foods are more likely to choose a healthier food item. As a result, to encourage healthy food purchasing behavior among low-income consumers, we should enact policies toward having perfect food labeling regarding the wording, design, and its location on the food packages and motivating people to use nutrition information.

This paper is organized as follows: the background and literature review will discuss the effects of food labeling and sociodemographic characteristics on food label viewing. This section will also explain the primary studies with an experimental analysis and the identified research gaps. In section 4, the experimental design and the summary statistics of the variables will be outlined in detail. This study's empirical strategies, estimated results, and conclusions will be provided in sections 5, 6, and 7, respectively.

2.2 Background and Literature Review

Studies on the labeling and signage of food packaging, their possible impacts on consumers' food choices, and healthy behavior have been considerably analyzed. This topic has significant importance and difficulty due to its economic and public health policy relevance. Considering current dietary behavior and taking consequent weight concerns into account, it should not be surprised if the food industry is blamed for the undesirable shifts in consumption behaviors (Dooley et al. [2010], WHO [2004]).

A large body of literature has investigated food labeling from the perspective of public policy, marketing, and consumer behavior since the late 1960s (Baltas [2001], Cowburn and Stockley [2003], Drichoutis et al. [2006]). The majority of research analyzed food labeling from a marketing perspective, claiming that providing enough and accurate information to consumers is the most significant element to improve the food decision-making process (Ippolito [1999], Wansink and Huckabee [2005]). Hence, all food packaging has to be labeled with specified nutrients and stated ingredients. In 1990, Congress developed a regulatory structure that promoted even more study, implementing the Nutrition Labeling and Education Act of 1990 (NLEA).

The debate over the efficiency of food labeling on consumers' health persists even with further studies. There are controversies over the success of provided information in transmitting desirable nutrition information to consumers and, more importantly, improving people's diet and lifestyle (Garde [2008], Seiders and Petty [2004]). Due to consumers' behavior's inherent complexity, the effects of food labeling modifications on people's shopping behavior cannot easily be observed.

This problem arises due to the multiple external and internal effects on cognition, perceptions, and behaviors and due to the consumers purposely ignoring the provided nutrition information (Rotfeld [2008a], Rotfeld [2008b], Rotfeld [2010]). Therefore, the pure impact of the food label modifications on consumers' behavior and real-world purchasing decisions would be difficult to demonstrate. Through a real-world shopping simulation, this study intends to shed light on the ambiguity in this topic.

In this section, a brief background of food labeling and signage is provided, followed by the literature review of studies on consumers' characteristics that affect nutrition information usages, such as personal factors and sociodemographic determinants. Next, the most related experimental studies in this area will be mentioned. In the last part of this section, the identified literature gaps that this study aims to answer will be discussed.

2.2.1 Food Labeling Modifications

The NLEA has significantly changed food labeling requirements in the history of food marketing in the U.S. and has been the motivation of many new studies since then. Under this law, label descriptions must include all aspects of the declaration of product information, clear nutrition facts tables, typical reference values, guidelines, health statements, and disclaimers.

In 2016, the Nutrition Facts Table on food packages was revised remarkably to reflect up-to-date scientific evidence; Nutrition facts tables must include information on the association between eating habits and some chronic diseases, such as obesity and heart diseases (FDA website). This update is supposed to make the food labels more comfortable to use and help consumers make better food purchasing decisions.

The most notable changes are as follows; a) serving size: an updated version, larger and bold font type; b) calorie: larger font type; c) daily values updates: such as adding a new item of "Added Sugars"; d) change in nutrition information: change in the required nutrients and declaring the actual amounts; e) footnote: new footnote explains more clearly what percent Daily Value means. Figure 2.4 shows a sample of the new Nutrition Facts label on food packages, which the FDA proposed in 2016. Figure 2.5 presents a side-by-side of the old and new label versions suggested by the FDA.

We begin by looking briefly at the literature regarding the nutrition table's format, characteristics, and wording styles. Then we will discuss the literature review related to people's food label usage while shopping. Subsequently, we will focus on the experiments conducted to estimate the consumers' characteristics affecting food label viewing and food purchasing decisions in real life.

The effectiveness of food labeling and health statement modifications on drawing people's attention have been analyzed significantly regarding the format and wording of them (i.e., the font type and way of showing the details). The examined modifications on food labeling include: (1) the items included in the nutrition fact tables; (2) the level of sophistication in the provided details, and (3) the amount of information.

Regarding the efficacy of the provided nutrition information on people's food label use and healthy decisions, most research has only analyzed consumers' *stated* preferences, the level of grasped learning, and the effects of the provided nutrition labels on their purchasing decisions. Regarding the level of details represented on the food labels, Muller [1985] found that consumers understand the nutrition facts with detailed information better than the summary ratings (the average of the nutrient values/nutrient ranges in a particular product classification), or descriptive words (for example, "this product is high/low in calorie"). (Asam and Bucklin [1973], Freiden [1981], Lenahan et al. [1973], Scammon [1977], Viswanathan and Hastak [2002]).

Examining the impact of the food label viewing on consumers' purchasing decisions suggests that consumers prefer more straightforward labeling and nutritional information panels convenient to use (Burton and Andrews [1996]). Several other empirical studies show that, although participants preferred a high level of detailed information, they could not properly use nutrition facts when faced with excessive information. (Block and Peracchio [2006], Burton et al. [1994], Hackleman [1981], Jacoby et al. [1977], Levy et al. [1996], Scammon [1977]).

Wansink [2003] carried out a further study to determine the efficient levels of nutrition facts and health claims on a product in response to the already-mentioned dilemma. The efficient level of information should provide enough nutrient information, and it is easy to comprehend. His results present that unnecessary knowledge discredits and misleads consumers, either it is excessive or too little. The author has demonstrated that brief claims on the front of the packaging combined with broader and informative nutritional information on the back of the package have substantially increased the customers' food label viewing and trust in the provided health claims on the food packages.

There are many studies on whether providing people with excellent food labeling will increase their actual use of food labels while shopping. The literature review of personal and sociodemographic characteristics affecting food label usage will be discussed in the following sections.

2.2.2 Consumers' Characteristics Associated with Nutrition Information Usage

In their study, Jacoby et al. [1977] stated that reading the supplied nutrition information and the effective use of this information is substantially different among consumers. It is also important to mention that the nutrition information viewing should be studied as a mid-stage for determining the impact of nutrition panels on consumers' comprehension and evaluation of product nutritiousness, purchasing decisions, and real consumption of that product.

The effects of changes in the nutrition facts table's structural format and health claims on improving nutrition label usage were described in the previous section. Other studies in this area focused primarily on consumers' personal factors and sociodemographic characteristics influencing food label use. A review of the literature is provided in the following sections.

2.2.2.1 Personal Factors

When facing the same food labeling format, people's specific characteristics may influence their interpretation of health claims and nutrition fact labels; ability, level of nutrition knowledge, and motivation are the most critical factors. A substantial degree of nutrition facts' comprehension and the ability to assess them (the level of nutrition knowledge) are proven to be the key factors of high label usage level while shopping.

Moorman [1990] analyzed the relationship between consumers' characteristics and label viewing while shopping and found that information regarding the adverse outcomes of the food item increases people's ability and involvement in assessing the nutrition information more accurately. These results were also shown in Muller's study [1985], showing that the product's negative health outcomes influence consumers' ability to interpret nutrition labels and health claims. Kemp et al. [2007] also suggested that this influence is considerably more significant where the presented information applies to risk evaluation of the diseases.

Wang et al. [1995a] examined the factors that impact a consumer's food label viewing using a qualitative response model focused on data from the 1987-1988 National Food Consumption Survey. Their findings indicate that economic, sociodemographic, and consumer health-consciousness variables are determinants of food label use. Their results also indicate that consumers' knowledge of nutrition's health benefits has a strong and statistically meaningful effect on the likelihood of food labels viewing. Some other findings are aligned with this study, such as Bass [1991], Feick et al. [1986], and Burton et al. [1994].

Szykman et al. [1997] observed the effects of food label usage in two circumstances. The authors analyzed the self-reported use of food labels first before and then after training people on the food nutrients' impact on blood pressure, heart disease, and cancer. Their results show a substantial increase in people's awareness and health statements and nutrition facts labels viewing (Klopp and MacDonald [1981]).

However, the undertaken research by Nayga Jr [2000] and Nayga Jr et al. [1998] did not show any apparent influence of nutritional awareness on the likelihood of food label use and healthy shopping behavior. They conclude that either consumers' nutritional knowledge is not a proper measurement of food label assessment ability (Nayga Jr et al. [1998]) or consumers could not employ their nutrition knowledge in the healthy food purchasing decisions (Nayga Jr [2000]). In light of these findings, Moorman et al. [2004] looked in more depth at the mechanism of individuals' searching and using nutrition information. Their findings elaborate on the specific factors affecting nutritional information use, indicating that consumers would only read and interpret data that meet their belief systems.

2.2.2.2 Sociodemographic Factors

The list of potential determinants for the use of nutrition information has been expanded with sociodemographic variables. Age, gender, household size, education, and income were included as possible predictors in the studies so far.

Research results on age as a factor affecting the nutrition facts viewing have been quite contentious. In the studies of Nayga Jr [2000], Wang et al. [1995b], and Klopp and MacDonald [1981], the age of a household's head is not the primary indicator of nutrition facts viewing. On the other hand, Cole and Balasubramanian [1993] showed a significant negative correlation between age and nutrition information perception, suggesting that elderly consumers appear to search less profoundly and less precisely than the younger population (Wang et al. [1995a]). The result compares to Moorman's [1990] finding that aging may enhance consumers' perception of their ability to assess the nutrition information; however, it adversely affects their interpretation ability.

Even though there has not been much study on gender as a socioeconomic forecaster, most studies report inconsistent results. In the studies of Nayga Jr [2000], Nayga Jr et al. [1998], and Klopp and MacDonald [1981], the use of labels by men and women while shopping seems to have no substantial difference. These results contradict the previous research on scanner data in which females make significantly greater use of labels than male shoppers (Mathios [1996]).

Household size as a predictor of label use has been examined in a few studies; however, the results consistently show the effect of family size on nutrition facts label viewing while shopping. The findings suggest that households with a greater number of members tend to use food labels more than smaller families, especially when they have a higher number of small children (Feick et al. [1986], Wang et al. [1995a], Wang et al. [1995b]).

In research studies, education and income are reported as the critical indicators of food label use among the socioeconomic variables. Education is reported to be related to the retention of information and healthy behavior in various contexts. Klopp and MacDonald [1981] indicating individuals with higher education are more likely to use nutrition food labels than people with lower education. Nayga Jr et al. [1998] suggest that this difference in label usage is due to the well-educated people's higher ability to perceive nutrition information and realize the importance of nutrients in general (Feick et al. [1986], Wang et al. [1995a], Wang et al. [1995b]).

In 2009, Viswanathan et al. [2009] contributed to the literature by estimating the effect of education on label use by concentrating on consumers' math and reading scores administered at the adult education center's entry. Their study indicated that summary information provided on food labels was comprehended by highly literate participants, proving that the literacy level significantly influences consumers' capacity to interpret food label information.

Unlike education, findings on income are contradictory. Nayga Jr [2000] and Feick et al. [1986] reported that income correlates with the level of individuals' knowledge but not necessarily the label viewing. In some other studies, authors found that higher-income shoppers use the nutrition facts panel more than lower-income people for food comparison. They showed that households' food label viewing is also related to the number of their food expenditures (Nayga Jr et al. [1998], Wang et al. [1995a], and Wang et al.

[1995b]).

2.2.3 Experimental Research

The sociodemographic and personal characteristics impacting consumers' label usage and, ultimately, their shopping decisions need to be analyzed more profoundly. Experimental research in supermarkets or laboratories with providing a close to real-world experience for individuals has helped the researchers understand consumers' behavior in more detail. With studies of people's choices in an experiment, we yield more insights on the predictors that explain consumers' food label viewing, perceive food label information, and effectively interpret the information improving healthy food purchasing decisions.

Some literature reviewed the neighborhood of low-income families regarding the access to local groceries and fresh fruit and vegetables and its effects on food purchasing decisions (Powell et al. [2007], Rose and Richards [2004], Galvez et al. [2008]). There is a limited number of studies on low-income consumers' food purchasing decision-making in the U.S. An effective intervention on households' food purchasing location, the grocery stores, is restricted by limited studies in this area.

Also, there is a lack of research on consumers' visual attention to food packages, signs, or displays (e.g., character, brand name, ingredients) and whether their attention level improves shopping decisions. The eye-tracking device has been very beneficial for the experimental analysis of visual attention to nutrition information. The eye-tracking device that can work with 2 to 8 cameras detects the head and eyes and where an observer is looking. An eye tracker's sensor can monitor the user's presence, attention, and focus. Figure 2.1 shows an example of where the cameras can be located.

Graham and Jeffery's [2011] study is an excellent example that uses the eye-tracking device, which contributed significantly to the research. The authors focused on finding the food packages' items that appear to be the most important factors to consumers and affect shopping decisions. They indicated that the food labels' location plays a primary role in grabbing people's attention. They also showed that the food labels located in the center of the screen were viewed more than others.

Before the experiment, participants were asked to rate how much they care about nutrition facts on food packages while shopping. An eye-tracking device was then used to measure how much time they spent reading the nutrition information. Graham and Jeffery's [2011] findings suggest that people highly overestimate food labeling's importance in their purchasing decisions. The experiment further demonstrates that participants read the information at the top of the nutrition facts table more than the bottom's ones.

Random utility models are traditionally being used for studying consumer choices under specific assumptions. The most important assumption is that consumers process all the attributes of the alternatives they face (McFadden [2001]). However, many researchers like Kahneman [2003], DellaVigna [2009], and Reutskaja et al. [2011] have challenged the reliability of this assumption.

In an experimental study, Thaler and Sunstein [2003] find that individuals do not consider all the attributes while making decisions among various food alternatives. Hensher et al. [2005], Scarpa et al. [2010], and Balcombe et al. [2015] conducted experiments in laboratories and found the same results claiming that some attributes are ignored by respondents, called attribute non-attendance (ANA).

All these experiments have used students as their respondents, and possibly cannot be qualified as a perfect representative of the whole population. Every single study in this field is valuable and sheds light on this subject; however, our understanding of the variables affecting the food label use still has many shortcomings and ambiguities. The complexity of consumers' behavior makes it fundamentally a challenging topic to be researched for decades to comprehend fully.

2.2.4 Summary of the Literature Review and the Identified Research Gaps

Food labeling might benefit consumers in certain situations; they have the appropriate knowledge to use nutrition information and are motivated to use them. There are still many unanswered questions in this area due to the ambiguous nature of human being's behavior. Therefore, examining different samples of participants in various situations is vital to understand the whole population's behavior to the fullest.

Regarding the reliability of food information interpretation, most label-framing studies suggest that the best labels concentrate only on the essential nutrition and health claims. These studies show that consumers prefer more simplified and straightforward food labels and nutrition fact tables. While consumers tend to favor more simplistic claims, it has also been shown that very basic information such as 'fat-free' and 'no cholesterol' could result in miscommunication. Therefore, the optimal amount of nutrition detail that could potentially help consumers make healthier food choices has not yet been adequately outlined. Some studies demonstrate that food labeling most often affects individuals who already have the motivation and awareness to use nutritional fact information.

In terms of personal factors, many studies conclude that consumers' motivation and an adequate level of information analysis ability play crucial roles in label viewing. Regarding the consumers' sociodemographic characteristics, most indicators have contradictory outcomes. Age does not appear to be a significant predictor of label use in most research; however, age's negative influence on individuals' perception has been found. The research on the impact of gender on food label viewing has provided contradictory results; A few studies find women use nutrition information more than males when shopping for food.

Household size is more likely to influence people's label usage positively. Education is the only socioeconomic variable that always shows a strong positive relationship with nutrition facts use. Some studies find that consumers who have less time to spend on shopping (i.e., higher income or more educated people) may show a reduction in label viewing. Two reasons can explain this: these individuals' overall commitment to healthy diets and nutrient use might be already strong, and consumers believe they can choose the best options without spending time reading nutrition facts. Alternatively, it can be explained by the fact that these people have more time constraints and less time to spend on shopping.

The random utility models are traditionally used to analyze people's characteristics and food label usage. These studies were done under the assumption that consumers consider all the attributes of the alternatives they face. Nevertheless, many other findings have challenged the reliability of this assumption. There is a need for research on customers' visual attention to food labels and health information and whether their attention level improves their shopping decisions. The eye-tracking device has been proved a practical tool for analyzing visual attention to nutrition fact information.

The primary literature gap is the lack of real-world oriented experiments to understand how consumers ultimately behave in their every-day food purchasing decision making. Laboratory research could yield significant insight into this challenging area of study. Most of the current findings are based on consumers' "self-reported" label use and healthy food choices during their shopping experiences. Therefore, the experimental research may add crucial contributions to addressing some of the "why" questions in this study area: what the reasons are behind the individuals' decisions to view food labels; whether changes in food labels' format motivate them to increase label use; and ultimately influence their healthy consumption choices.

The major weakness in the existing experimental research is the type of sample employed in the experiments. The overuse of undergraduate students to portray the general population may lead to a failure in comparing the effects of education, incentive, and nutrition information level on food label use, which can misrepresent experimental outcomes. Alternatively, concluding based on the results from an all-female sample population can be misleading, as some studies have demonstrated that there are critical gender-specific impacts on nutrition and balanced diet (Hassan et al. [2010]). This study contributes to the literature by a diverse sample of participants in terms of gender and education.

Furthermore, there is limited research on how low-income consumers make food purchasing decisions in the U.S. The shortage in this study area restricts successful interventions that benefit individuals with low income. According to the results shown in chapter one, the government should provide low-income people with more nutrition awareness and health-related information. In chapter one, we observed that merely providing the SNAP-eligible with more money could not improve their health. In this experimental study, by targeting SNAP-participants, a greater insight into low-income consumers' food purchasing decision-making is provided. As a result, the government will be able to enact more beneficial policies for the targeted population. In the following section, the experimental design and the collection of the self-reported information and measured data after the experiment will be described, followed by the variables' summary statistics.

2.3 Data

2.3.1 Experimental Design

This experiment's initial target population was 100 low-income individuals in Champaign County, Illinois, in the Champaign Urbana Public Health District (CUPHD), our chief community partner. Participants were invited to participate in the experiment while waiting in the waiting area at the CUPHD service. They received $20 (gift certificate) for their participation in the experiment. The number of participants in the experiment eventually fell to 57. All these 57 people were SNAP-recipients (Supplemental Nutrition Assistance Program) except for one person, which was excluded from this study's analysis. As a result, all the participants in this study are SNAP-recipients.

The eye-tracking equipment was set up in the conference room of CUPHD, and all the steps of the experiment were carried out in this private room. Individuals employed to participate in the study were first checked for any constraints on the family diet. Participants were also questioned if they can read English words and whether they had any vision issues. If the participant does not have any constraints, informed consent was granted and instructed to take up the simulated grocery shopping task that lasts about 45 minutes.

Using the *Smart Eye Pro* eye tracker, which can be expanded from 2 to 8 cameras, the grocery-store task was enabled, facilitating 360° head and eye detection and tracking. The Smart Eye Pro tracker is an eye and head tracking device without any disruptions and is one of the best eye-trackers in the market for eye-tracking data collection. The face is immediately identified and tracked by a head tracking algorithm. The machine gathers more data and acquires more information about the face, and builds a profile for that subject with repeated tests. Furthermore, over time, the performance of the system increases. In Figure 2.1, a prototype installation indicates where cameras were placed for this experiment.

In this experiment, three main variables are involved as influential factors in people's shopping decisions: (1) Nutrition facts table (e.g., calorie amounts, fat, sugar, sodium), (2) central image (e.g., spokes-characters), and health information (e.g., "lower cholesterol"), as well as (3) price. Two examples of the choice sets with the actual tracking data by the eye-tracking device and the following calculated percentage time spent on each part of the slide are provided in Figures 2.2 and 2.3.

Some specific guidelines were provided to the participants before starting the experiment: "Assume that you are in a real supermarket and shopping for groceries. Please review each set of items and choose which one you would buy if you were in a real supermarket." Participants were faced with the choices of "Would buy" or "would not buy", and one of those two options was selected in their final decisions. In order to mitigate order effects and wear-out, the display order of the products was randomized. A simulated grocery shopping framework was created with the software of SmartPro.

Pre-tests were carried out to assess the survey and stimulation questions' efficiency. Low-income people waiting in other health services sections (e.g., dental care) at the Champaign-Urbana Public Health District took part in the pre-testing process. Clarifying the terminology of the questions, labeling stimuli, and listed food objects, where necessary, were adjusted after the pre-testing.

During the experiment, 34 different food choice sets were shown to participants at a time in random order. Their gaze time on each part and their final choices were collected during the exercise. Figures 2.2 and 2.3 display an initial and the final eye-tracker analysis on a slide shown to a participant. Documenting the duration of participants' fixations on the slides' areas of interest is doable with the eye tracker, which can be used for attention assessment and a cognitive processing predictor. When the experiment was over, participants were asked to complete a survey about their sociodemographic characteristics, height and weight statistics, a range of behavioral questions, etc.

Through the experiment, analysts were able to track what items caught participants' attention and what information was disregarded. All videos from the experiment were evaluated by gaze time and the number of fixations on the critical items and coded on the screens to find the most and least attractive parts of the food packages (Figures 2.2 and 2.3). The variables of interest in this study are either self-reported or measured, and their summary statistics will be provided in the next section.

2.3.2 Summary Statistics

As explained above, participants are asked to complete a questionnaire at the end of the experiment. Therefore, we have access to their self-reported sociodemographic characteristics, along with other information about their lifestyle, eating habits, behavioral information, shopping experience in general, and the factors they pay attention to while shopping. In addition, we have access to the number of seconds that people looked at the areas of interest using the eye-tracker's data.

In this experiment, we are interested in the food choices that people make; the final decision participants made for each pair of food items will be identified. So, in this study, there are two types of variables: self-reported and measured variables. The definitions, categories, and summary statistics of the study's variables are provided in the following section. The detailed information of variables is presented in Table 2.1.

2.3.2.1 Self-reported Variables

Income: Income is a self-reported variable, where there are four categories of monthly household income for all participants. Since all participants are SNAP-eligible people, it is not surprising to observe that the majority have a monthly household income of less than $800.

Education: Education is a self-reported variable categorized in the following groups: some high school, high school graduates, some college, college graduates, and post-graduates. There were not enough participates in the post-graduates group, so we combined college graduates and post-graduates. About 45% of individuals have "some college" education.

Gender: Participants' gender is a self-reported characteristic categorized as female or male. In the sample of this study, about 73% of the participants are males.

Source of Nutrition Knowledge: A few questions are related to the participants' level of nutrition knowledge and the sources they obtained their knowledge of. They responded to the following questions: "In the past 12 months, how often have you watched nutrition, food, or diet shows on television?"; "In the past 12 months, how often have you read nutrition, food, or diet sections of a newspaper or magazine?" and "In the past 12 months, how often have you used the internet to find information about nutrition, food, or diet?".

If their response is once a week or more, their nutrition knowledge is categorized as good nutrition knowledge, and poor nutrition knowledge when responding less than once a week. These variables are also included in this study's estimated models: three variables for "nutrition-knowledge by TV, newspaper, or internet" to see whether the sources of nutrition knowledge make any difference in people's shopping behavior.

Age: Participants' age is reported as a continuous variable. The average age of participants is about 40 years old, with a min of 18 and a max of 67 years old.

2.3.2.2 Measured Variables

Nutrition Fact Label Usage: The eye-tracking device tracks the areas of food packages that catch participants' attention through the experiment. The device evaluates all the videos taken from the experiment by gaze time to find the most and least engaging items on the food packages. We employ label-use as the dependent variable of the first model to answer the research's first question. We have access to the gaze time on the nutrition facts table and calories for each slide's left and right items.

Based on the study of Balcombe et al. [2015], Attribute Non-Attendance (ANA) is defined as an attribute that people's gaze time on that is less than two seconds. Food labels or nutritional fact tables are considered as an attribute that a rational consumer should visually pay attention to in their shopping experience during the experiment. Therefore, if participants' fixation count on the nutrition fact table (time spent on nutrition fact table and calorie) was zero or 1 second (less than two seconds), they are grouped as not using the food labels. Thus, the food label usage variable is zero if the time spent on nutrition fact tables of two food items in one slide is less than two seconds combined. Food label use equals one if the participants spend at least 2 seconds on the mentioned items. Consumers used food labels for their purchasing decisions, on average, about 60% of the time.

Healthy Food Purchasing Decision: During the experiment, participants have to choose between two food items presented in each slide, choosing either "would buy" or "would not buy" options. After the experiment, the participants' frequency of choosing the healthier food item over the unhealthy one is calculated. If a person chooses a healthier food item for more than 50% of the slides, the variable of "healthy food purchasing decision" would be equal to one, and zero if otherwise. On average, SNAP-eligible people chose a healthier food item over the unhealthy one in 46% of the events.

Label Version: In 2016, the U.S. Food and Drug Administration (FDA) revised the Nutrition Facts labels on food packages to help consumers make better food purchasing decisions. The most significant changes are in the following items: serving size, calorie, daily values, provided nutrition information, and footnotes. Figure 2.4 shows a sample of the Nutrition Facts label on packaged foods, updated by the FDA in 2016. Figure 2.5 presents a side-by-side of the old and new label versions presented by the FDA.

During the experiment, to test the new version of the nutrition fact tables' efficiency, about half of the participants are randomly shown the old version of the food labels, and the rest are shown the new ones. Figures 2.6 and 2.7 are the samples of slides in the experiment that depict a "new" and "old" slide version.

Label Location: It is well known in the marketing studies that consumers' attention can be changed toward specific attributes by labeling and health information's modifications. Another hypothesis tested in this study is whether the shift in food labels' placement would eventually change consumers' attention to nutrition fact tables and improve participants' food purchasing decisions.

Therefore, 50% of the participants were shown the slides with the nutrition fact tables in the center, and the rest were shown the slides with the food images in the center. We want to test whether changing the food labels' placement could grab more attention and result in a higher level of food label viewing and selecting healthier foods. Therefore, the policymakers might be able to recognize the optimal placement of the food labels with more in-depth experiments in the future. Figures 2.8 and 2.9 show the samples of slides in the experiment that depicts a "slide location with nutrition tables in the center" and "slide location with images in the center", respectively.

Slide's Food Type: Another measured variable is the type of food on the slides shown to the participants. The food types are categorized into eight main groups: whole grains, protein, dairy, vegetables, snacks, syrup and sauce, juice, and meal foods. The whole grain and snacks categories are the prominent food types in the slides. The empirical analysis, models, results, and conclusions will be explained in detail in the following sections.

2.4 Empirical Strategy

According to the findings outlined in chapter one, an increase in SNAP benefits by ARRA was not enough to improve SNAP-eligible individuals' health. Therefore, the government needs to enact policies that raise health awareness and nutrition knowledge for consumers. By targeting SNAP participants, this experimental study improves our understanding of food purchasing behavior and preferences among low-income people. It also can guide the government to enact more efficient policies for SNAP-eligible consumers' health advancement. The primary objectives of this chapter are:

- Examining whether SNAP participants pay attention to the nutrition fact information while making their food purchasing decisions.
- Finding the personal and sociodemographic characteristics that affect label usage.
- Examining whether the new proposed nutrition table version by the FDA in 2016 encourages people to use the food labels' information while shopping.
- Testing if the nutrition information location on food packages can affect people's attention and change their nutrition facts label viewing.

- Estimating the effects of label viewing on the improvement of SNAP-recipients' food purchasing decision making.

2.4.1 Nutrition Fact Table Usage While Shopping

This study's first and second targets are estimated by a Probit Model of the food label usage on independent variables explained in the summary statistics section. Following the study of Balcombe et al. [2015], if participants' fixation count on the nutrition fact table is less than two seconds, they are considered non-food label users. Therefore, this Probit model's dependent variable is zero if the time spent on the nutrition facts tables of the two food items in a slide is less than two seconds combined. The label use equals one if the participants spend at least 2 seconds on the mentioned items.

Wang et al. [1995a] and [1995b] examined the factors that affect customers' use of food labels and found that economic, sociodemographic, and consumers' "health-consciousness" variables are the leading effective indicators. Their findings also show that consumers' knowledge of nutrition's health benefits has a strong and statistically meaningful impact on the likelihood of food label viewing. Many other conclusions are aligned with this study, such as Bass [1991], Feick et al. [1986], and Burton et al. [1994].

One of the most valuable insights we get from the questionnaire completed after the experiment is the individuals' self-reported nutrition knowledge level. This variable was added to the model as the leading personal characteristics. Since we have access to the participants' self-reported knowledge source, the sources' possible influences on label viewing can be separately defined. The details regarding the definition of these variables are provided in section 2.3.2. Participants' socioeconomic characteristics, such as income, education, age, and gender, are also added to this model to examine the effects of the main sociodemographic variables, which were analyzed in the previous papers and mostly proved influential.

Label characteristics are included in the model to achieve the third and fourth goals of this study. The label version helps us examine whether the new version of the FDA's nutrition facts table influences SNAP recipients' attention to food labels. The version of the nutrition labels was randomly assigned to the participants. The label location variable can answer the fourth question of this research by testing whether the nutrition fact table's placement can affect consumers' food label viewing.

The first estimated model would be the following binary Probit model. We could identify the relationship between a binary dependent and certain independent variables using a Probit model. In other words, the dependent variable (F) can take two values of {0,1}; F= 1= Nutrition Fact Table Usage, and F= 0= No Nutrition Fact Table Usage. We include X as the personal and sociodemographic variables and L as label characteristics (label version and location) to test their impacts on SNAP-recipients' food label viewing. Then the Probit regression of dependent variable on predictor variables evaluates the values of parameters β and γ with the maximum likelihood method.

$$F = \beta X + \gamma L + \epsilon \tag{2.1}$$

β predicts the effects of consumers' personal and sociodemographic variables on nutrition fact table use, and γ estimates the impacts of food label characteristics on nutrition fact table usage.

In the next step, the marginal analysis of the variables of interest will be provided. This analysis is used to elucidate the partial relationship between nutrition fact table use and participants' and label's characteristics while holding all other variables constant. The marginal analysis provides a more in-depth explanation of how changes in participants' characteristics and label attributes influence the likelihood of using food labels as other contributing factors remain constant. In the last step, the Average Marginal Effect (AME) is estimated to illustrate the partial effect of certain variables on the likelihood of a given alternative. The average marginal effect (dy/dx) for categorical variables estimates the probability of a discrete change from the base level.

2.4.2 Consumers' Intention to Make Healthy Food Choices

As outlined at the beginning of this section, this study's last target is to estimate the effects of label usage and personal and sociodemographic variables on improving consumers' food purchasing decisions.

The sample in our study is SNAP recipients and very low-income households. Therefore, according to the findings of chapter one and all the previous studies, these people tend to purchase cheaper and less healthy foods, which negatively affects their health. This makes it critical to examine what characteristics influence food label viewing among SNAP consumers and whether using food labels results in purchasing healthier food items.

The effects of food label version and placement on label use are already estimated in the first model. In the following model, the effects of nutrition fact table viewing on SNAP-eligible consumers' food purchasing decisions are estimated. Suppose the results show that nutrition table-use encourages consumers to purchase healthier foods. In this case, the government should start to accurately examine the optimal version and placement of nutrition tables on food packages to improve low-income people's food choices.

The second model is estimated by a Probit regression, the same as equation 1, since the outcome variable is binary. The outcome variable would be equal to 1 if the participant selects a healthier food in more than 50% of the slides, and 0 otherwise. The primary independent variable of interest in this model is food label use. Examining whether the nutrition facts table viewing improves SNAP consumers' healthier food choices is this model's primary aim.

Although the primary independent variable is food label use, participants' personal and sociodemographic characteristics may also affect people's food purchasing decisions. Therefore, the same variables applied in model 2.1 should also be included in this model.

$$H = \beta X + \delta F + \epsilon \tag{2.2}$$

Where H is the healthy food purchasing decision, X is the vector of exogenous personal and demographic characteristics. F is the dummy variable for food label use (F=1 if the participants use the nutrition fact table in their food purchasing decision making, and 0 otherwise).

This model can cause a misinterpretation due to the familiar issue of self-selections bias. This problem might happen since the food label use decision is voluntary. If food label viewing results from a participant's self-selection, there is a high chance that food label users have systematically different attributes than non-label users. Therefore, we have a heterogeneity problem in our sub-samples since unobserved characteristics may influence both of food label use and healthy decision making. Hence, the estimation of the effects of food labels on healthy decisions would be inconsistent.

2.4.2.1 Instrumental Variable

An Instrumental Variable (IV) could be applied in the model to solve the mentioned problem: unobserved characteristics may affect both nutrition facts table use and healthy food purchasing decision making. A perfect IV has to be highly correlated with the food label usage and uncorrelated with making healthy choices.

$$H = \beta F + \epsilon \tag{2.3}$$

Where H is the dependent variable (healthy choice), and F is the endogenous independent variable (nutrition fact table use). Variable I can be used as an IV if it is significantly correlated with the food label use and uncorrelated with the error term (unobserved characteristics of the food label users).

The label characteristics are the potential candidates to be applied as an IV in this model. As we will see in the first model's results, label location and label version significantly affect the food label viewing (Cov $(I,F) \neq 0$). On the other hand, label characteristics cannot influence healthy food choices unless through the label viewing (Cov $(I,\epsilon) = 0$). So, label characteristics are highly correlated with food label use and share no correlation with healthy food choices. As a result, label characteristics can be applied as the instrumental variables to find the effects of food label use on healthy decision making.

Before estimating the Probit model's coefficients with IV, a joint significant f-test of two proposed IVs is estimated. In the following section, the IV Probit model finds the effects of consumers' sociodemographic characteristics and food label use on healthy purchasing decision-making, which are precisely explained. The explanatory variables' average marginal effects on the healthy choice decision-making are estimated in the next step.

2.5 Results

According to the empirical strategy explanations, two main models are estimated to find the answers to this study's key questions. The results of these principal regression models are explained in the following sections:

2.5.1 Nutrition Facts Table Use While Purchasing Food

In model 2.1, a Probit model was used to analyze the effects of consumers' personal and sociodemographic characteristics on food label usage. Furthermore, observing the effects of label characteristics (label location and label version) on the food label usage is another target of the first model. Therefore, all the self-reported and measured variables (explained in the Data section) are included in the first Probit model. The estimated coefficients are provided in Table 2.2. Since the Probit model's coefficients are not informative, the predictive margins and average marginal effects (AME) for the statistically significant variables are also estimated.

2.5.1.1 Predictive Margins

The predicted margins (probabilities) of each variable of interest, while holding all other characteristics constant, are estimated to elaborate the partial relationship of nutrition table usage with the participants' characteristics and food label features. This marginal analysis provides us with a better insight into how changes in personal characteristics or label formats affect the food label viewing as we do not allow other factors to influence that change. The marginal effects of the significant explanatory variables and label usage once controlled for all other characteristics are provided in Tables 2.3, 2.4, 2.5, 2.6, and 2.7. The corresponding graphs are shown in Figures 2.10, 2.11, and 2.12(a) - 2.12(e).

The marginal effect of label location on the food label use is shown in Table 2.3. The findings indicate that, for the slides with the nutrition table in the center, the probability of using the nutrition information while shopping is 93%. If we place the product's image in the center, this probability is 28%, which is significantly less than placing the nutrition fact table in the center. The label location variable is statistically significant with a 99% confidence interval. The corresponding graph is presented in Figure 2.10.

The next indicator of the label characteristics is the food label version. As explained before, the new version of the nutrition fact table was introduced by the FDA in 2016. So, it is crucial to see how effective these changes are in grabbing SNAP-participants' attention. Marginal analysis of the label version on nutrition table fact use is provided in Table 2.4 and Figure 2.11. The results indicate that the new version of the nutrition table can encourage people to pay attention to them. The probability of label usage with the new version is 61%, compared to the old version with 56%.

The participants' source of nutrition knowledge is included in the Probit model as a personal indicator of food label use along with the other sociodemographic variables. In the previous studies regarding the sociodemographic factors, most indicators have contradictory outcomes. Age does not appear to be a significant predictor of food label use in most research. Study on gender differences has provided contradictory results. The effects of income on consumers' food label usage are often shown inconsistent findings; however, education mostly shows a positive effect on nutrition facts viewing during shopping.

The predictive margins of the statistically significant personal and sociodemographic variables are provided in Tables 2.5 and 2.6 and the corresponding graphs are shown in Figures 2.12(a) - 2.12(d). TV and newspapers as participants' nutrition knowledge sources show highly significant effects on the nutrition facts table viewing while shopping. The results show that people who obtain an adequate level of knowledge from TV are very likely to use nutrition tables while shopping (66%); however, this probability is less with a lower nutrition knowledge level (57%). Participants claiming the newspaper as the source of knowledge have a lower chance of food label viewing (47%) with a self-reported good information level compared to the poor nutrient-knowledgeable consumers (63%).

The results show an adverse effect of higher income on food label usage (Table 2.5), which may be explained by Nayga Jr [2000] and Nayga Jr et al.' [1998] findings suggesting that people with more time constraints spend less time reading the food labels. Since the effect of education is controlled in the model, when income increases, people spend less and less time on shopping and, as a result, on food label viewing. Another reason provided in these studies explains that high-income or high-educated people have already engaged in a healthy lifestyle and dieting, so they know what to purchase "by heart" and do not need to spend time reading the food labels. The marginal analysis of income on food label use shows that as the effects of other variables are controlled, high-income consumers use food labels with a predicted probability of 52%, compared to 66% for the low-income group.

Other variables in the model did not have a statistically significant effect on the food label use. The probability of the nutrition facts table usage increases only for consumers who are college graduates compared to less than high school education. Gender is also a statistically insignificant indicator, consistent with most studies indicating no effect of gender on label-use. Its coefficient is positive; showing females have a higher probability of using food labels than males. Although age is not a significant indicator of label viewing and consistent with most previous works, it positively affects the probability of nutrition information usage. Slides' food type did not show a significant effect for either of its categories; however, its related predictive margins are shown in Table 2.7, and the corresponding graph is shown in Figure 2.12(e).

2.5.1.2 Average Marginal Effect Analysis for Nutrition Facts Table Use

The Average Marginal Effect (AME) of the explanatory variables is estimated to show the partial effect on the probability of choosing a given alternative. Average marginal effects (dy/dx) for categorical variables estimate the probability of a discrete change from the base level. The detailed findings from AME estimation for significant variables are provided in Table 2.8.

The AME results for food label characteristics show that placing the nutrition table in the center increases the likelihood of food label viewing drastically by 65% compares to the slides with food images in the center. So, the nutrition information location plays a critical role in encouraging SNAP-participants' food label use. Observing the results of the nutrition facts tables' old and new versions shows the new version of the nutrition table raises the consumers' food label viewing by 5% in comparison with the old version.

On average, the likelihood of using nutrition information labels among high-income people is 14% lower than the base group (monthly household income less than $400). Consumers with high nutrition knowledge received from TV and newspaper/magazine are, on average, 9% more likely and 16% less likely to use nutrition fact tables versus less health-knowledgeable consumers, respectively.

2.5.2 Consumers' Intention to Make Healthy Food Choices

The effect of nutrition fact table viewing on healthy food purchasing decision making is the primary independent variable of interest in this model; however, consumers' personal and sociodemographic characteristics that impact healthy food purchasing are also identified in this model. It was explained in section 2.4.2.1, SNAP-participants' unobserved characteristics may affect both food label viewing and food purchasing decision-making and cause the selection bias problem. Therefore, a useful IV has to be selected and included in this model to find the true effect of food label viewing on consumers' food choices.

The proposed IVs are food label characteristics: label location and label version. These two variables are potential IV candidates since both were already found to have high effects on food label usage. These variables cannot have any correlations with healthy choices unless through label viewing. The F-test results for joint significance of these two IVs are provided in Table 2.9. The results indicate that these two variables are significantly different from zero together, influencing food label use.

Therefore, to solve the endogeneity problem, the next Probit model with proposed IVs is estimated, and the results are provided in Table 2.10. In the next step, the average marginal effects for statistically significant variables are calculated and presented in Table 2.11.

2.5.2.1 Average Marginal Effect Analysis for Healthy Food Choices

The average marginal analysis finds that the nutrition fact viewing is a statistically significant indicator of healthy food purchasing decisions with a 99% confidence interval. On average, while holding all other variables constant, the probability of purchasing a healthy food item is 6% higher for consumers using food labels while shopping than the consumers ignoring the food labels.

Therefore, consumers who use nutrition information for their food purchasing decisions are more likely to choose the most nutritious food options, while other variables are held constant. As a result, encouraging SNAP-participants to read the nutrition information on food packages when making food purchasing decisions increase the probability of SNAP participants' spending benefits on healthier foods.

All the nutrition knowledge sources significantly influence people's decisions making. Individuals using newspapers and the internet as sources of knowledge have a higher likelihood of choosing a healthier food item with 9% and 11%, respectively; however, the obtained information from TV shows a high negative effect on healthy food purchases. The results suggest that consumers who gather nutrition information from newspapers or the internet are more knowledgeable about healthy eating and more likely to choose healthier food items. It might be due to the fact that consumers reading the information from a newspaper or the net are more focused or self-motivated than people who believe they have the adequate nutrition knowledge level by watching TV.

The findings related to education show that the college graduate level positively influences the probability of consumers' healthy food purchasing. The probability of choosing a healthier food item increases by 24% when consumers are college graduates. The results of AME also show that aging has a small positive effect on healthy food purchasing decisions.

Even though the probability of food label viewing is higher among females (results of model 2.1), the likelihood of choosing healthy food items among females is, on average, 12% less than males. This result suggests that females may read food labels more than males, but they may not be nutrient-knowledgeable enough to adequately use nutrition information. Income is the only statistically insignificant indicator of healthy food choices while the other influential variables are held constant; however, higher-income positively affects healthy food purchasing decision making.

2.6 Conclusions

The findings of chapter 1 suggest more SNAP-allotment after ARRA 2009 increased SNAP-eligible individuals' BMI and negatively affected their health. Therefore, providing low-income individuals with more monetary benefits does not necessarily improve their health status. The government should also instruct people with nutrition knowledge toward healthier eating habits. As explained in the literature review, the most effective policy changes should be in supermarkets and grocery stores where food shopping happens. The most potent intervention could be on the food packages refinement, especially the nutrition facts table, to draw consumers' attention.

This study aims to answer the primary questions regarding the nutrition facts table viewing and healthy food choices among the SNAP participants. An experimental analysis successfully achieved the following objectives via an eye-tracker device: What are low-income consumers' personal and sociodemographic characteristics that affect food label viewing while shopping? Whether the new version of the nutrition facts table introduced by the FDA in 2016 impact food label viewing? Does food label location affect nutrition table viewing? Do consumers who pay attention to the nutrition facts tables while shopping have healthier food choices?

There has been a controversy over the nutrition fact table's effectiveness in grabbing consumers' attention while making food purchasing decisions. The FDA introduced a new version of the nutrition fact table with significant modifications: font size, provided information, and food label format due to making it more informative and easier to read. In this study, the effects of the new version of the nutrition facts table suggested by the FDA among SNAP-recipients are analyzed. The results show the new version of the nutrition facts table increased consumers' viewing by 5%.

Moreover, there have been some debates in the literature review, especially from the food marketing perspective, that food labels' location could change consumers' attention. In this study, the effects of the nutrition facts table's placement on catching low-income consumers' attention are examined. Half of the participants were randomly assigned with the slides with the nutrition facts table in the center. The change in the food label's location was used to measure food label placement effects on grabbing consumers' attention. The marginal analysis shows that the nutrition facts table's location can change consumers' attention. SNAP-participants who observed the slides with food labels in the center viewed the nutrition facts table significantly higher by 65%.

Furthermore, according to the literature, there is a big question mark over the effects of the nutrition facts table viewing on consumers' food purchasing choices. In order to shed light on this ambiguity, a Probit model with the instrumental variables is estimated. As shown in the previous model, the nutrition facts table's version and location are significant food label viewing indicators. Also, food label characteristics are only able to affect food purchasing decisions through food label viewing. Therefore, these two variables are used as IVs for food label viewing in this model. The findings show a positive effect of nutrition facts table viewing on healthier food purchasing decisions.

The results suggest that SNAP-participants' personal and sociodemographic characteristics influence food purchasing decision-making. An increase in income negatively impacts label viewing, consistent with previous studies; People with more time constraints spend less time shopping; however, higher-income individuals are more likely to purchase healthier food items. Although college graduates are more likely to choose healthier foods than less educated people, the education effect on food label viewing is not statistically significant. Gender and age do not affect food label viewing; however, they do impact food purchasing decisions. Males are more likely to purchase healthier foods than females. Also, as people are getting older, they tend to purchase more nutritious food items. The results indicate that consumers with a different source of nutrition knowledge have different food purchasing behavior.

This study's findings suggest that the government can enhance SNAP-recipients' food purchasing decisions through different areas. First, they need to find the most compelling way to convey adequate nutrient knowledge to low-income people. The more educated and nutrient-knowledgeable the consumers are, the healthier food choices they make. Second, the FDA successfully increased the consumers' attention to the nutrition facts tables by implementing the new version; however, there is still much space for improving food labels. Lastly, the nutrition facts table location can affect consumers' food label viewing. Therefore, it is crucial to find the right place for a nutrition facts table on food packages to catch more attention.

With an experimental analysis, this study contributes to the existing literature of food label viewing and low-income food purchasing decision-making; however, it is not without limitations. First, this experiment was conducted in a laboratory on a computer, which makes this task more similar to online shopping than grocery shopping. Online grocery shopping is not as widespread as shopping in a brick-and-mortar grocery store; however, people's shopping behavior has changed significantly since the pandemic started, and customers' online shopping increased sharply. With the changes in shopping behavior, the simulated food shopping in this study would not be that far away from the real-world shopping experience. Using the eye-tracking device to capture consumers' food label viewing in supermarkets could be a future study to contribute to this topic extensively.

Second, the findings of an experimental analysis where people are being monitored might be criticized. A few studies note that the act of monitoring might influence participants' behavior (Hay et al. [1980]; however, this inference has been challenged by other studies (Gardner [2000]). In case the participants in the eye-tracking experiment were aware that their eye movements on the nutrition fact table would be monitored, we may challenge this study's results; We may claim that being monitored may pressure participants to change their natural behavior (view food labels or choose the healthier food items).

Nevertheless, to prevent this issue, some steps were taken before the experiment. First and foremost, participants in the experiment did not receive any detailed information about the experiment's target except that they would be involved in the food purchasing tasks. Also, SNAP-recipients were invited to take the experiment while waiting in a clinic, where there was no indication that researchers are interested in nutrition table viewing or healthy behaviors. Furthermore, people were asked to complete the questionnaire after the experiment to deter people's natural behavior during the experiment.

In conclusion, according to the results of Chapter 1 (quantile regression), some SNAP-eligible consumers improved their health (lower BMI) by ARRA-related SNAP-benefit expansion; however, others were influenced negatively (higher BMI). As a result, enhancing SNAP-eligible individuals' health needs more consideration and structural improvements. The findings in Chapter 2 unveils that the nutrition fact table's location and version affect SNAP-participant consumers' attention and may improve their food shopping behavior. The most influential place to impact consumers' food purchasing decisions should be supermarkets and grocery stores. Moreover, the most significant impression could be made by fundamental changes on food labels with further and profound studies. The findings from this tremendous eye-tracking experiment on SNAP-participants can be expanded in future studies.

2.7 Tables and Figures

Table 2.1: Summary Statistics

Variables	Frequency	Percent	Cumulative Percent
Income			
less than $400	374	20.75	20.75
$401 to $800	884	49.06	69.81
$801 to $1200	272	15.09	84.91
$1201 and higher	272	15.09	100
Education			
some high school	102	5.36	5.36
high school graduates	442	23.21	28.57
some college	850	44.64	73.21
college graduates	510	26.79	100
Gender			
male	1394	73.21	73.21
female	510	26.79	100
Source of Nutrition Knowledge			
TV			
poor	1,462	76.79	76.79
good	442	23.21	100
Newspaper			
poor	1,292	67.86	67.86
good	612	32.14	100
Internet			
poor	850	44.64	44.64
good	1,054	55.36	100
Nutrition Fact Label Usage			
less than two seconds	719	40.76	40.76
more than two seconds	1,045	59.24	100
Healthy Purchasing Decision			
choosing healthier foods less than 50%	1,020	53.57	53.57
choosing healthier foods more than 50%	884	46.43	100
Label Version			
old	918	48.21	48.21
new	986	51.79	100
Label Location			
image in the center	952	50	50
nutrition table in the center	952	50	100
Slide's Food Type			
whole grains	448	23.53	23.53
protein	280	14.71	38.24
dairy	168	8.82	47.06
vegetables	280	14.71	61.76
snacks	336	17.65	79.41
syrup and sauce	168	8.82	88.24
juice	112	5.88	94.12
meal foods	112	2.88	100.00

Variables	Mean	SD	Min	Max
Age	39.82	14.53	18	67

Notes: All variables are binary variables. Age is the only continuous variable in the models.

Table 2.2: Probit Regression for the Nutrition Facts Table Use Among SNAP-Participants

Dependent Variable			
Nutrition Facts Table Use	**Coefficient**	**Standard Error**	**z**
Label Location			
nutrition table in the center	2.22***	0.10	22.49
Label Version			
new version	0.22*	0.10	2.17
Source of Nutrition Knowledge			
TV			
good level of Knowledge	0.37***	0.11	3.28
Newspaper			
good level of Knowledge	-0.74***	0.12	-6.16
Internet			
good level of Knowledge	0.17	0.10	1.65
Education			
high school graduates	-0.10	0.20	-0.49
some college	-0.24	0.2	-1.24
college graduates	0.07	0.22	0.34
Income			
$401 up t0 $800	-0.29*	0.12	-2.3
$801 up t0 $1200	-0.44**	0.14	-3.1
$1201 and higher	-0.59***	0.15	-3.98
Gender			
female	0.03	0.11	0.3
Age	0.0006	0.003	0.18
Slide's Food Type			
protein	0.13	0.13	1.06
dairy	-0.04	0.15	-0.27
vegetables	-0.04	0.13	-0.36
snacks	-0.07	0.12	-0.54
syrup and sauce	-0.07	0.15	-0.47
juice	-0.002	0.18	-0.01
meal foods	-0.14	0.17	-0.78
Number of observations	1,671		
LR chi2 (14)	830.94		
Prob > chi2	0.00		
Pseudo R2	0.37		

Notes: The symbols ***(p < 0.001), **(p < 0.01), and *(p < 0.05) indicate significance levels.

Table 2.3: Predictive Margins of Label Location

Predictive Margins				
Label Location	**Margin**	**Delta-Method Standard Error**	**z**	**P>|Z|**
image in the center	0.28	0.01	19.16	0.00
nutrition table in the center	0.93	0.009	102.82	0.00
Number of observations	1,671			

Table 2.4: Predictive Margins of Label Version

Predictive Margins				
Label Version	**Margin**	**Delta-Method Standard Error**	**z**	**P>|Z|**
old	0.56	0.02	34.27	0.00
new	0.61	0.01	42.51	0.00
Number of observations	1,671			

Table 2.5: Predictive Margins of Income Level

Predictive Margins				
Income	**Margin**	**Delta-Method Standard Error**	**z**	**P>|Z|**
less than $400	0.66	0.02	27.43	0.00
$401 up t0 $800	0.59	0.01	41.88	0.00
$801 up t0 $1200	0.56	0.02	23.39	0.00
$1201 and higher	0.52	0.03	20.11	0.00
Number of observations	1,671			

Table 2.6: Predictive Margins of Participants' Source of Nutrition Knowledge

Predictive Margins				
Source of Nutrition Knowledge	**Margin**	**Delta-Method Standard Error**	**z**	**P>|Z|**
TV				
poor level of Knowledge	0.57	0.01	50.84	0.00
good level of Knowledge	0.66	0.02	28.793	0.00
Newspaper				
poor level of Knowledge	0.63	0.01	57.01	0.00
good level of Knowledge	0.47	0.02	24.63	0.00
Internet				
poor level of Knowledge	0.57	0.02	34.67	0.00
good level of Knowledge	0.61	0.01	41.29	0.00
Number of observations	1,671			

Table 2.7: Predictive Margins of Slide's Food Type

Predictive Margins				
Slide's Food Type	**Margin**	**Delta-Method Standard Error**	**z**	**P>|Z|**
whole grains	0.59	0.02	31.92	0.00
protein	0.63	0.02	26.75	0.00
dairy	0.58	0.03	19.26	0.00
vegetables	0.58	0.02	24.85	0.00
snacks	0.58	0.02	26.73	0.00
syrup and sauce	0.59	0.04	15.68	0.00
juice	0.59	0.04	15.67	0.00
meal foods	0.56	0.04	15.12	0.00
Number of observations	1,671			

Table 2.8: Average Marginal Effects of Significant Indicators on the Nutrition Facts Table Use

Dependent Variable		
Nutrition Facts Table Use	**dy/dx**	**Delta-Method Standard Error**
Label Location		
nutrition table in the center	0.65***	0.02
Label Version		
new version	0.05*	0.02
Source of Nutrition Knowledge		
TV		
good level of Knowledge	0.09***	0.03
Newspaper		
good level of Knowledge	-0.16***	0.02
Internet		
good level of Knowledge	0.04	0.03
Income		
$401 up t0 $800	-0.07*	0.03
$801 up t0 $1200	-0.11**	0.03
$1201 and higher	-0.14***	0.03
Number of observations	1,671	

Notes: dy/dx for factor levels is the discrete change from the base level.
The symbols ***(p < 0.001), and **(p < 0.01) *(p < 0.05) indicate significance levels.
The table shows AME estimation's results for significant variables only.

Table 2.9: Joint Significance F-test of the Instrumental Variables

(1) [Nutrition Facts Table Use] **Label Location = 0**	
(2) [Nutrition Facts Table Use] **Label Version = 0**	
	chi2 (2) = 515.09
	Prob > chi2 = 0.00

Table 2.10: Probit Regression of Healthy Purchasing Decision Making - Instrumental Variables

Dependent Variable			
Healthy Decision	**Coefficient**	**Standard Error**	**z**
Nutrition Facts Table Use	0.95***	0.12	8.26
Source of Nutrition Knowledge			
TV			
good level of Knowledge	-0.95***	0.11	-8.90
Newspaper			
good level of Knowledge	0.41***	0.11	3.77
Internet			
good level of Knowledge	0.30**	0.10	3.13
Education			
high school graduates	-1.13***	0.19	-6.06
some college	-0.07	0.18	-0.37
college graduates	0.80***	0.20	3.97
Income			
$401 up t0 $800	-0.14	0.11	-1.31
$801 up t0 $1200	0.05	0.12	0.42
$1201 and higher	0.09	0.13	0.65
Gender			
female	-0.42***	0.11	-3.69
Age	0.03***	0.003	7.35
Instrumented:	nutrition facts table use		
Instruments:	label location, label version, source of nutrition knowledge, education, income, gender, age		
Log Likelihood	-1370.98		
Number of observations	1,416		
Wald chi2 (12)	408.44		
Prob > chi2	0.00		

Notes: The symbols ***(p < 0.001), and **(p < 0.01) *(p < 0.05) indicate significance levels.

Table 2.11: Average Marginal Effects of Significant Indicators on the Healthy Purchasing Decision Making

Dependent Variable		
Healthy Decision	**dy/dx**	**Delta-Method Standard Error**
Nutrition Facts Table Use	0.06***	0.03
Source of Nutrition Knowledge		
TV		
good level of Knowledge	-0.27***	0.03
Newspaper		
good level of Knowledge	0.09***	0.03
Internet		
good level of Knowledge	0.11**	0.03
Education		
high school graduates	-0.37***	0.06
some college	-0.04	0.06
college graduates	0.24***	0.06
Gender		
Female	-0.12***	0.03
Age	0.007***	0.001
Number of observations	1,416	

Notes: dy/dx for factor levels is the discrete change from the base level.
The symbols ***(p < 0.001), and **(p < 0.01) *(p < 0.05) indicate significance levels.
The table shows AME estimation's results for significant variables only.

Figure 2.1: The eye-tracker set-up for the experiment

Figure 2.2: A sample of a slide displaying the actual tracking data by the eye-tracker device

Figure 2.3: A sample of a slide displaying the calculated numbers by the eye-tracker device
Note: The figure shows all the attributes displayed to the participants during the experiment. Participants' percentage time spent on each area of interest is calculated and shown by the eye tracking device after the experiment.

Figure 2.4: A sample of the nutrition facts table updated by FDA in 2016

Figure 2.5: A sample of a side-by-side old and new nutrition fact table versions suggested by FDA

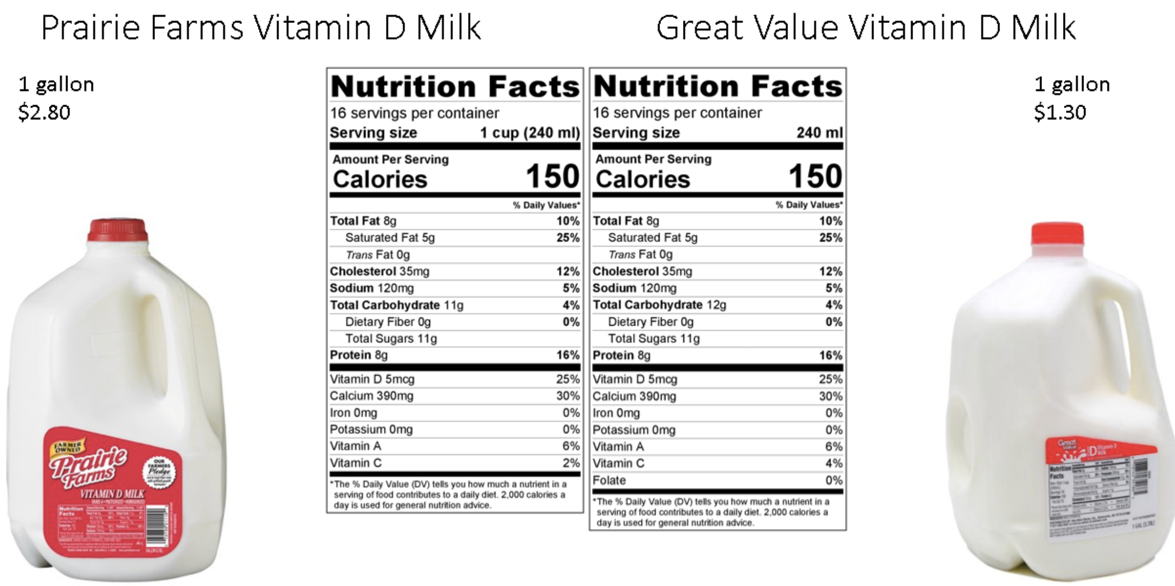


Figure 2.6: A sample of a slide with a "new" nutrition facts table version used in the experiment

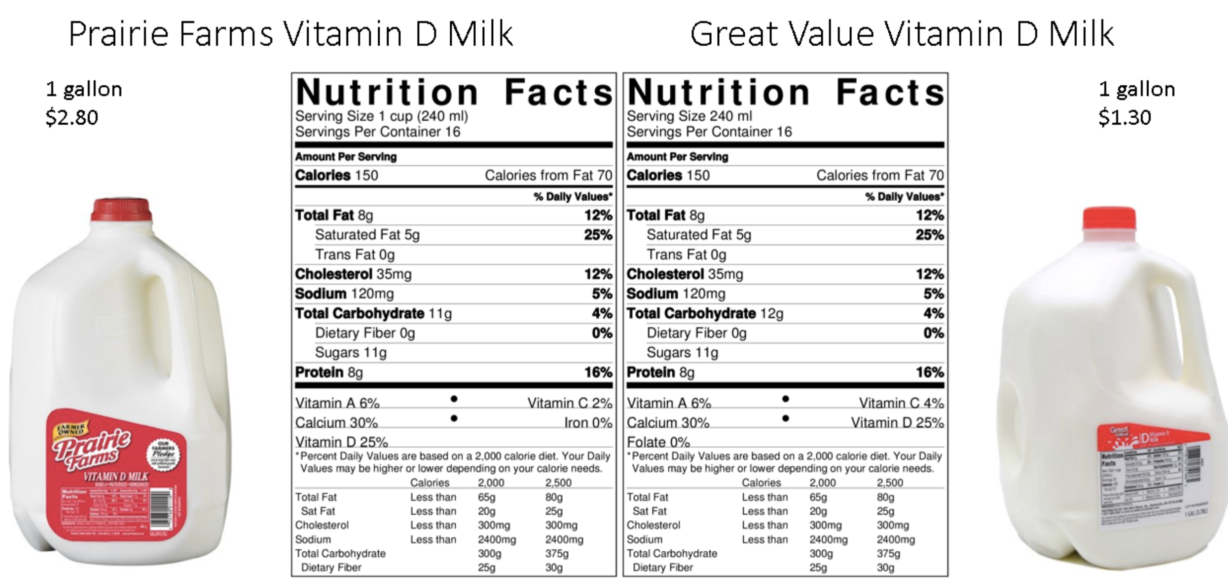


Figure 2.7: A sample of a slide with an "old" nutrition facts table version used in the experiment

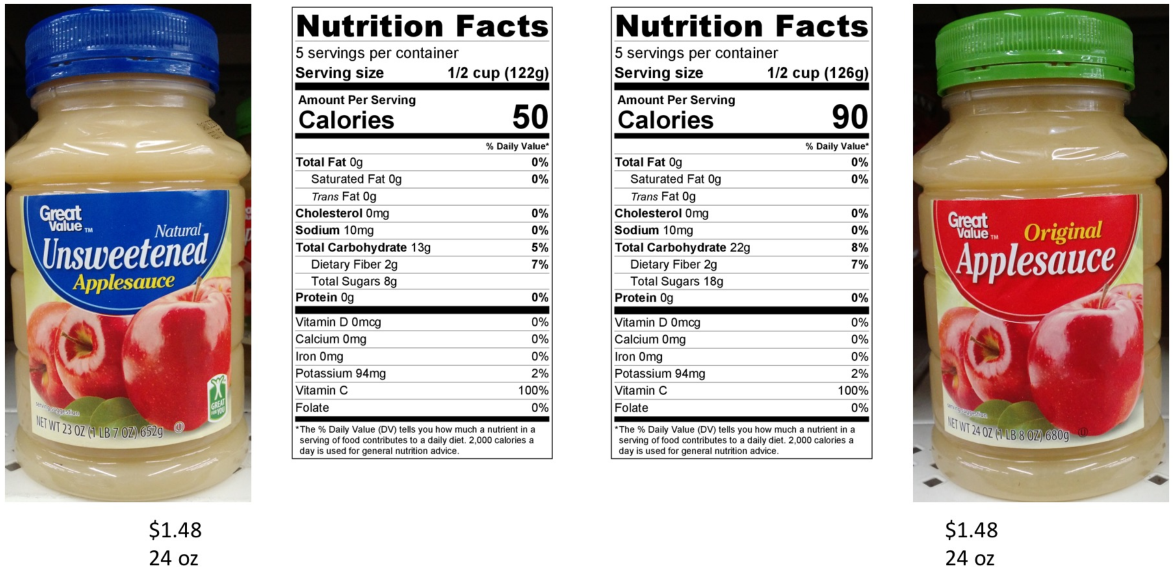


Figure 2.8: A sample of a slide depicts a "label location - nutrition facts tables in the center" used in the experiment

Figure 2.9: A sample of a slide depicts a "label location - food images in the center" used in the experiment

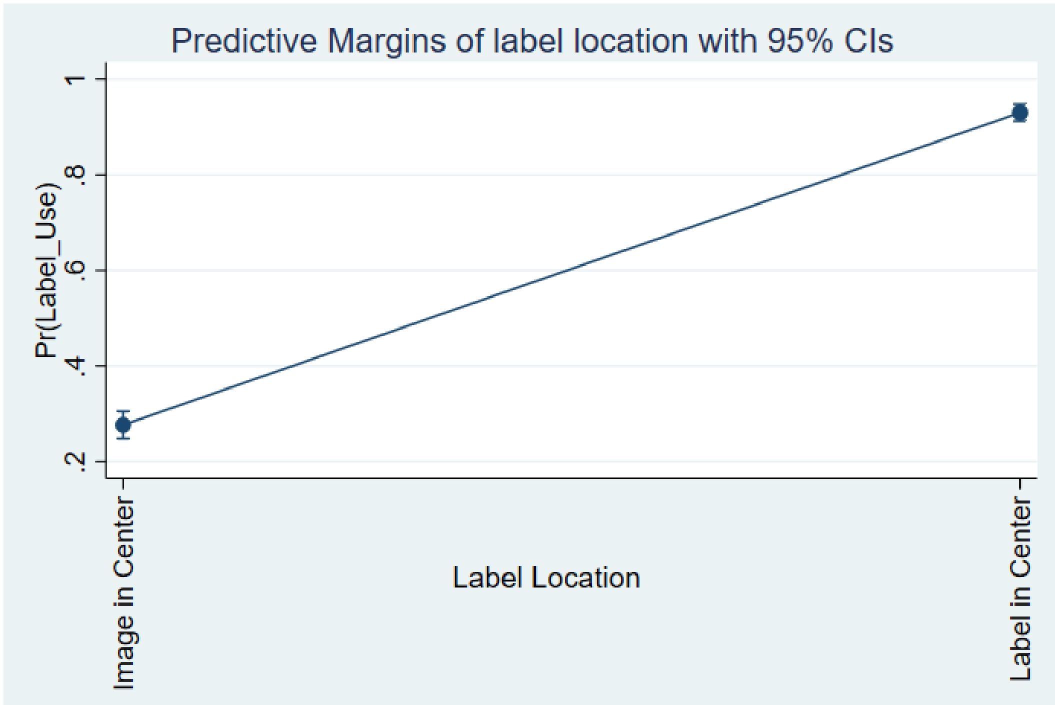


Figure 2.10: Predictive margins of label location - nutrition fact table use

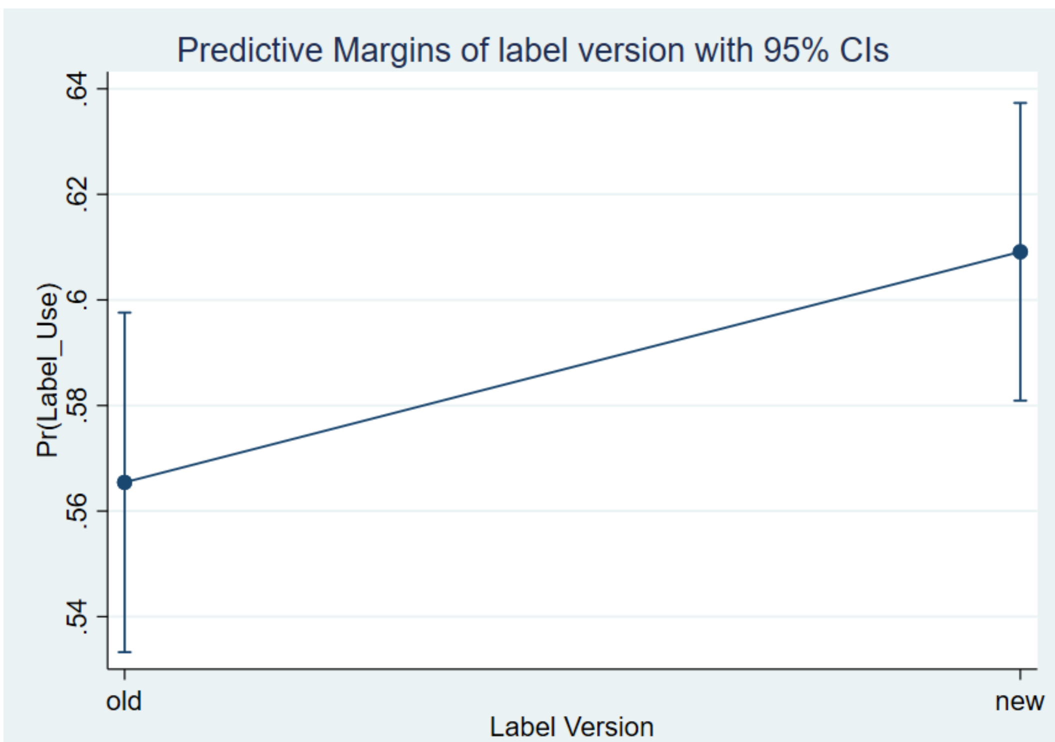
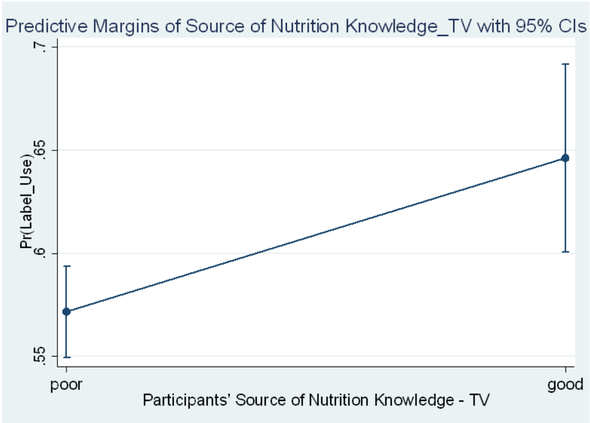
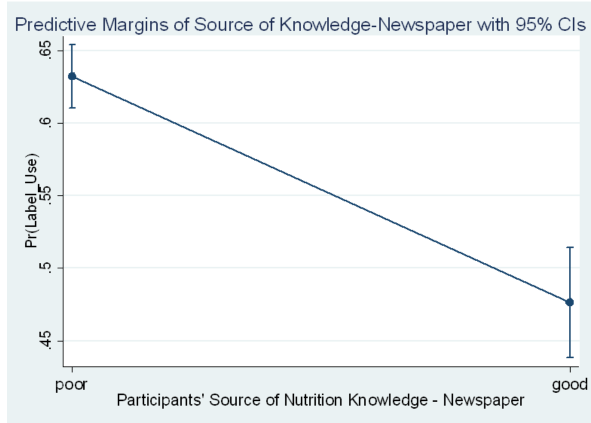


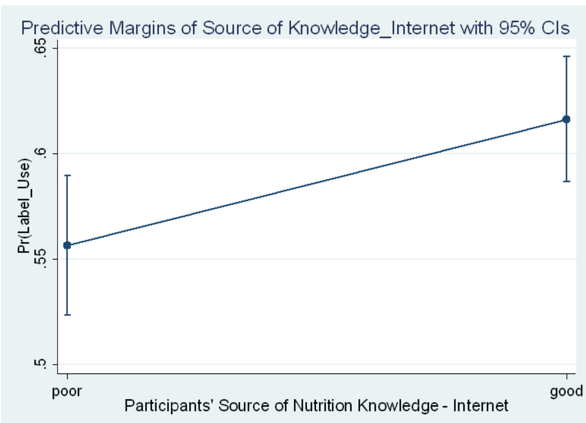
Figure 2.11: Predictive margins of label version - nutrition fact table use



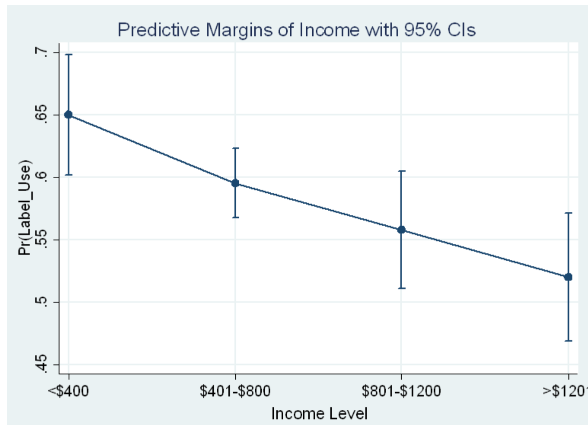
(a) Nutrition Knowledge Source - TV



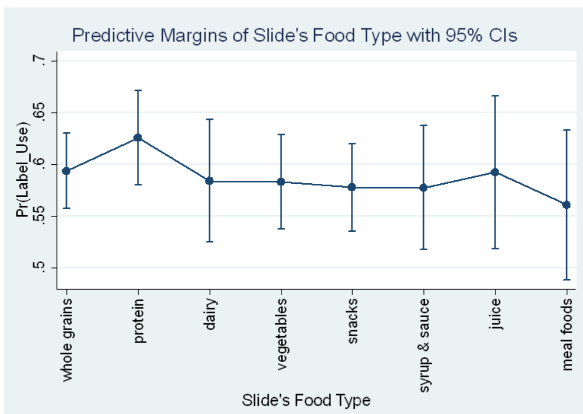
(b) Nutrition Knowledge Source - Newspaper



(c) Nutrition Knowledge Source - Internet



(d) Income Level



(e) Food Type

Figure 2.12: Predictive margins of nutrition knowledge source/ income/ food types - nutrition fact table use

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