The Effects of Food Labeling and Dietary Guidance on Nutrition in the United States

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Abstract

Food label regulations, dietary guidance, and nutrition education have continually evolved to address emerging health and nutrition concerns in the United States. Using the most recently available data from the National Health and Nutrition Examination Survey 2007-2008, this study examines the individual characteristics associated with food label use and estimates the effect of using food labels on nutrient intake. Using an instrumental variables methodology I find that using the Nutrition Facts panel (NFP) decreases total calories consumed per day by 120 kilocalories, just shy of the calories in one can of regular soda, and enough to explain at least an 11 pound difference in steady state body weight. In general I find that, using food labels may reduce CVD risk and facilitate the management of body weight and diet-related health conditions such as hypertension. The results provide evidence that food labels and dietary guidance have helped consumers make healthier choices and that they have the potential to help those who do not yet use these tools.

Keywords: Food labels, nutrition facts, health claims, nutrient intake.

JEL Codes: H18, I10, I18.

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List of abbreviations and acronyms

AI	adequate intake
CSFII	Continuing Survey of Food Intake by Individuals
CVD	cardiovascular disease
DD	Difference-in-difference
DGA	Dietary Guidelines for Americans
DHA	docosahexaenoic acid, type of ω-3 FA
DHHS	U.S. Department of Health and Human Services
EPA	eicosapentaenoic acid, type of ω-3 FA
FA	fatty acid(s)
FAH	food at home
FAFH	food away from home
FDA	U.S. Food and Drug Administration
FGP	Food Guide Pyramid
HC	health claim
HDL	high-density lipoprotein
HEI	Healthy Eating Index
IV	instrumental variables
kcal	kilocalorie
LDL	low-density lipoprotein
LTPA	Leisure time physical activity
MUFA	mono-unsaturated fatty acid
NFP	Nutrition Facts panel (a.k.a., Nutrition Facts label)
NHANES	National Health and Nutrition Examination Survey
NLEA	Nutrition Labeling and Education Act of 1990
OLS	ordinary least squares
ω	omega
PUFA	poly-unsaturated fatty acid
RDA	recommended daily allowance
USDA	U.S. Department of Agriculture

1. Introduction

Obesity has emerged as one of, if not the most, pressing health issue of the 21st century. The prevalence of obesity among adults in the United States increased from 13.4% to 35.9% between 1960 and 2010, making obesity prevention (especially among children) and treatment a national priority (Levi et al. 2010; Flegal et al. 2012). Recently some have argued that rising obesity rates increase global energy demand and pose a greater threat to the security of the global food supply than overpopulation does (Walpole et al. 2012). Diet, physical activity, genetics, the built environment (e.g., neighborhood walkability and recreation facilities), and other health behaviors (e.g., smoking) all play a role in the development and severity of obesity (Weinsier et al. 1998). Thus, much obesity prevention and treatment policy attempts to provide consumers with the tools and resources that will enable them to increase time spent in physical activity, choose healthier foods, and as a result, lose weight, or at least avoid weight gain.

Together with other government agencies, the U.S. Food and Drug Administration (FDA) and United States Department of Agriculture (USDA) work to increase consumer knowledge about nutrition and the consequences of an unhealthy diet with the hope that consumers will place a greater value on their health and adopt more healthful dietary patterns. For instance, USDA began publishing food guides and dietary advice in 1894 and, together with the Department of Health and Human Services (DHHS), continues to provide nutrition education and guidance with the regularly updated *Dietary Guidelines for Americans* (USDA and DHHS 2010; USDA 2011). FDA also acts to safeguard consumers from misinformation by regulating the Nutrition Facts panel (NFP), restaurant menu labeling, and labeling statements (including health claims) made on food packaging and labels. FDA aims to provide consumers with science-based nutrition information that they can use to make healthy food choices (FDA 2009; FDA 2012).[1]

Much research exists on the determinants of food label understanding, use, and nutrition knowledge, but less is know about whether reading and understanding food labels changes the food choices consumers make and the subsequent health outcomes they experience (Blaylock et al. 1999; Wardle et al. 2000; Rothman et al. 2006). To date the studies by Kim, Nayga, and Capps (2000; 2001) and Variyam (2008) have presented the most compelling evidence on the effect of food labeling on diet and nutrient intake. Kim, Nayga, and Capps (2000) found that food label users consumed less total fat, saturated fat, and cholesterol and more fiber than they would if they did not use the food label. Similarly, Kim, Nayga, and Capps (2001) found that individuals who used product ingredient lists and food label health claims had Healthy Eating Index (HEI) scores 3.5 and 6.1 points higher than they would if they did not use the ingredient list or health claims. Variyam (2008) used a difference-in-difference (DD) model and found that the introduction of NLEA and use of the NFP increased intakes of both fiber and iron by approximately 7%. Lin and Lee (2004) and Lin, Lee, and Yen (2004) found evidence that the relationship also runs in the other direction, (i.e., from dietary intake to label use) and that individuals who consume healthier diets use food labels to maintain a healthy diet.

This study contributes to the literature on the effects of food labels and dietary guidance on dietary intake and nutrition in several ways. First, I use the most current data on food label use, dietary guidance use, and dietary intake available for the United States. Second, I describe the consumer characteristics associated with the use of various sources of nutrition information including: the NFP, food label health claims, ingredient lists, serving

[1]The Patient Protection and Affordable Care Act of 2010 requires restaurant chains with 20 or more locations, and other retail food establishments, to provide the calorie content for each item listed on the menu or menu board however, the final rule has not been published yet and the mandatory compliance date will occur at some time after FDA publishes the final rule. The Nutrition Labeling and Education Act (NLEA) of 1990 went into effect in 1994 and gave FDA the authority to (i) require nutrition information be provided on food products and (ii) regulate health claims made on labels. Label claims include (i) nutrient content claims, (ii) health claims, (iii) qualified health claims, and (iv) structure or function claims (FDA 2009).

size information, awareness of fast-food and sit-down restaurant menu labels, intent to use restaurant menu labels, and the use of a USDA MyPyramid meal plan (i.e., dietary guidance). As suggested by Lin and Lee (2004), I allow for the possibility that psychological factors and self-perceptions affect both label use and dietary intake. Lastly, I evaluate the effect of food label and dietary guidance use on the intake of a wider range of nutrients, including those identified as nutrients of public health concern in the *Dietary Guidelines for Americans, 2010*. To my knowledge this is the first study to identify the characteristics associated with the intent to use restaurant menu labeling and to quantify the effects of using a specific dietary guidance meal plan on nutrient intake.

Section 2 summarizes the existing literature on the effects of food label use on diet. Section 3 describes the data used in this analysis, Section 4 outlines my empirical strategy, Section 5 presents and discusses the results and discusses the potential health benefits of label use. Lastly, Section 6 concludes the paper.

2. Background

Households combine food, non-food, and time to produce meals and health, from which they derive utility (Becker 1965; Grossman 1977; Blaylock et al. 1999). Theoretically, food labels that contain information about the characteristics of a food product will reduce the effort needed to compare products and increase consumption of relatively healthy foods (Russo et al. 1986). Labels may highlight the positive characteristics (e.g., reduced-sugar or zero *trans*-fat) of a product, but will also have to include its negative characteristics (e.g., high % daily value of sodium per serving) on the requisite NFP and in the list of ingredients.[2] However, consumers also value and take safety, convenience, environmental impact, taste, and price into account when making food choices. The importance of these factors may outweigh the importance of health and nutrition even when consumers know about and understand

[2]For more information about the Nutrition Facts panel and other regulated food label information please see: `www.fda.gov`.

the links between diet and health (Blaylock et al. 1999). Using a small mail survey Lusk and Briggeman (2009) found that respondents more often ranked food safety, price, or taste, rather than nutrition, as the most important food characteristic. Regulating the content and format of the NFP and health claims made on food labels provides consumers with credible information they can use when choosing between various food items (Variyam 2005).

However, the extent to which consumers understand and use the ingredient and nutrition information provided on food labels varies significantly. Researchers have consistently found an association between label use and income, gender, race, age, and education (Lewis et al. 2009; Ollberding, Wolf, and Contento 2010). Consumers with higher incomes and more education have a greater probability of using food labels, and they also have a greater ability to use the information provided on the label (Cowburn and Stockley 2005; Rothman et al. 2006). Using cognitive processing facilities (rather than non-cognitive or automatic) to make food choices takes effort and causes fatigue, which may reduce self control and ability to process information thereafter (Cohen and Babey 2012).[3] Some research has focused more broadly on the effects of food marketing and packaging on consumption. Chandon (2012) summarized the evidence for the existence of "health halos," which make foods seemingly more healthful (e.g., having fewer calories) than they actually are, and can lead consumers to over-consume.

We know less about whether food labeling and dietary guidance policies affect behavior or, if they do, how those changes affect dietary patterns and health. Elbel et al. (2009) studied the effect of restaurant menu labeling in New York City and found that the labels increased consumer awareness about calorie content, but they did not reduce the number of calories purchased (and presumably consumed). Bollinger, Leslie, and Sorensen (2010) estimated that mandatory calorie labeling at Starbucks in New York City reduced the average calorie content per purchase by 6 percent. Numeracy, the order that restaurants list menu

[3]Individuals often make food choices hastily, using contextual cues such as pictures, brands, and prices, without taking the long-run effects of that choice into account. That is, individuals use non-cognitive or atomic processes to make many decisions about food (Cohen and Babey 2012).

items in, and a preference for information presented in images rather than text probably contribute to this finding (Cohen and Babey 2012). Variyam, Blaylock, and Smallwood (1996) found that nutrition knowledge (but not necessarily label use) significantly increased the dietary fiber intake of individuals. Using an endogenous switching regression framework and data from the 1994-96 Continuing Survey of Food Intake by Individuals (CSFII), Kim, Nayga, and Capps (2000) estimated that using the information about total fat, saturated fat, cholesterol, fiber, and sodium on food labels decreased consumption of sodium, total fat, saturated fat, and cholesterol and increased consumption of fiber for label users. Kim, Nayga, and Capps (2001) used the same data and methodology to evaluate the effect of label use on the HEI scores and found that label use increased the HEI scores of label users by 3.5–6.1 points. Variyam (2008) used a DD model to estimate the effect of using the NFP and found that it increased the consumption of both fiber and iron by about 7%. Along with several waves of data from the National Health Interview Survey, Variaym and Cawley (2006) also used a DD model to estimate the effect of the NLEA on obesity. Variaym and Cawley (2006) found that only the body-mass-index of white women who used nutrition information declined significantly in the years following the implementation of NLEA.

Motivated by the possibility that the perceived benefits of label use or the discomfort individuals experience from inconsistencies between their perceived and actual behavior (i.e., cognitive dissonance) affect label use, Lin and Lee (2004) and Lin, Lee, and Yen (2004) tested whether dietary intake affected the probability of using food labels. Cognitive dissonance theory predicts that nutrient intake affects food label use if individuals purposely choose to expose themselves to and use information that does not contradict their preferred behavior (Festinger 1957). Using the 1994-96 CSFII Lin, Lee, and Yen (2004) found that individuals who consumed relatively greater amounts of saturated fat, total fat, and cholesterol had a lesser propensity for label use and that the perceived importance and benefits from label use also affected the probability of label use. Lin, Lee, and Yen (2004) also found that the perceived importance of nutrition when grocery shopping and the amount of confidence consumers had in their ability to use food labels to choose a healthy diet significantly increased the probability that individuals used the information about total fat, saturated fat, and cholesterol on the food label. However, individuals who felt that using food labels took too much time had a significantly lower probability of using all three types of food label information. Thus, the results presented in Lin and Lee (2004) and Lin, Lee, and Yen (2004) motivate the inclusion of measures of the psychological factors that may influence both nutrient intake and the propensity for food label use.

Cognitive dissonance theory also suggests that individuals who do not associate negative health outcomes with specific food choices or dietary patterns (i.e., individuals who do not experience dissonance from consuming unhealthy items) have a high probability of avoiding nutrition information (dissonant information) and low probability of making a healthier food choice (revising their original decision) in the future (Frey 1982). This suggests that increasing awareness about the relationship between dietary patterns and health outcomes could change behavior by increasing the dissonance of consuming an unhealthy diet. It also suggests that individuals who perceive that they eat a healthy diet have the greatest propensity to seek out and use food labels and dietary guidance because this behavior coincides with their perception of themselves.

To identify a causal relationship between label use and nutrient intake researchers must overcome selection bias issues. Individuals who report using food labels and dietary guidance have systematically different characteristics than those who do not report using labels and these differences will likely affect their dietary patterns, and thus, researchers cannot directly compare the two populations. To my knowledge, only Kim, Nayga, and Capps (2000, 2001) and Variyam (2008) have addressed the selection bias issues present in this vein of research. Given the ever-changing food label and dietary guidance landscape, and the growing concern about obesity, the relationships and effects Kim, Nayga, and Capps (2000, 2001) and Variyam (2008) estimated have probably changed.

3. Data

I use the National Health and Nutrition Examination Survey 2007-2008 (NHANES 07-08) survey in this study. The NHANES 07-08 survey contains information on demographic characteristics, diet recall and nutrient intakes, physical exam measurements, blood test results, and a consumer behavior questionnaire. The consumer behavior questionnaire and follow-up components of NHANES 07-08 contain information about food label awareness and use.[4] Among many other things, the questionnaire asked respondents if they had heard of the Food Guide Pyramid (FGP) and MyPyramid, if they had ever used a MyPyramid food plan, how frequently they shopped for food, and if they served as the primary food shopper and meal preparer for the household. Respondents also indicated whether they had seen nutrient information in fast-food and sit-down restaurants, whether they used that information when choosing which items to consume, and if they would use it if it were available. I exclude pregnant women, individuals with missing income and dietary intake information, individuals under 18 years of age, and individuals aged more than 70 years. The final sample contains 4,068 observations. Tables 1a and 1b contain summary statistics for a selection of relevant individual characteristics and Figures 1–4 illustrate nutrient intakes by NFP use for the final sample.

[**Table 1a.** Summary Statistics: Individual Characteristics]

Over half of sample respondents made a major grocery shopping trip at least once a week ("frequent shoppers"), did the majority of the grocery shopping for the family (shopper), or did the majority of the food preparation for the family (preparer). The NHANES respondents reported a much lower share of food expenditure on food-away-from-home (FAFH) (26.6 %) than estimated by the Economic Research Service (2012) for 2007-2008 (48 %). One in ten individuals reported having a food allergy and 7% of individuals said they had type 2

[4]Note that this survey represents the first NAHNES conducted after the FDA amendment requiring manufacturers to list *trans*-fat content (if $\geq$ 0.5gm per serving) took effect on January 1, 2006 (FDA 2003). The *trans*-fat rule made the first and only changes to the NFP format since NLEA went into effect in 1994.

diabetes. While 48% of respondents said they thought about the nutritional value of foods when they shopped for groceries, only 30.5% thought they had an excellent or very good diet. Women in the sample had an average waist circumference of 94.8 cm and weight of 168.3 lbs. Men had an average waist circumference of of 99.9 cm and weight of 195.5 lbs. Based on waist circumference and BMI, the average respondent belonged in the overweight or obese category and had an increased risk for cardiovascular disease (Zhu et al. 2005). Approximately 14% of respondents reported eating a special diet and 23% reported that someone in their family ate a special diet. About 3% and 1% of individuals in the sample said that they had extreme difficulty with reading ordinary news print or seeing items on a crowded shelf. These two vision issues may make individuals less likely to use food labels, restaurant menu labels, or dietary guidance.

[**Table 1b.** Summary Statistics: Food Label and Dietary Guidance Use]

Although very few individuals reported using the menu labels in fast-food and sit-down restaurants (6.4% and 6.5%), approximately twice as many people had seen menu labels in a fast-food (16.1%) or sit-down restaurant (12.4%). Low awareness of restaurant menu labeling is not surprising given that menu labeling has not become mandatory nationwide yet, although many restaurants voluntarily provided all menu labels at the time of the survey.[5] However, about half of respondents indicated that, if it were available, they would use restaurant menu labels when selecting a menu item. One in four respondents knew about the FGP. The majority of respondents indicated that they used the NFP (61.2%) or health claims (50.0%) always, most of the time, or sometimes.[6] Nearly 10% said they always used the NFP and 5.6% said they always used label health claims. Approximately one in five individuals reported using a MyPyramid food plan.

[5]For example, King County, WA (Seattle), New York City, NY, Oregon, and California preempted the federal menu labeling regulations by passing state laws or local ordinances requiring menu labeling. For more information see: `http://www.publichealthadvocacy.org/resources_menulabeling.html`.

[6]Specifically, NHANES 2007-2008 asked respondents "Some food packages contain health claims about the benefits of nutrients or foods.... How often do you use this kind of health claim when deciding to buy a product?"

[**Figure 1.** Energy Intake by Nutrition Facts Panel Use]

[**Figure 2.** Calcium and Sodium Intake by Nutrition Facts Panel Use]

[**Figure 3.** Fat Intake by Nutrition Facts Panel Use]

[**Figure 4.** ω-3 and ω-6 FA Intake by Nutrition Facts Label Use]

[**Figure 5.** Vitamin D Intake by Nutrition Facts Panel Use]

[**Figure 6.** Diet Composition by Nutrition Facts Panel Use]

[**Figure 7.** Diet Composition by MyPyramid Meal Plan Use]

[**Figure 8.** Health Conditions by Food Label Use]

The average sample person consumed 2,174 kilocalories (kcal) per day, with 33.6%, 49.0%, and 16.0% from total fat, carbohydrates, and protein, respectively (see Appendix Table A1). The average respondent consumed 392 more kcal more than necessary to sustain life given their current body weight (i.e., calories surplus). As Figure 1 illustrates, in comparison to nonusers, individuals who reported using the NFP consumed fewer total kcals (323 kcals/day) and a lower calorie surplus. In the full sample an average 11.1% of kcal per day came from saturated fat, just over the 10% maximum recommended in the *Dietary Guidelines for Americans* (DGA), *2010* (see Figure 3). Individuals who reported using the NFP consumed fewer grams of ω-3 and ω-6 FA per day on average than nonusers (see Figure 4). The average sodium intake equaled more than twice the recommended daily allowance (RDA) of 1,500 mg per day while fiber consumption lay far below the daily adequate intake (AI) for males (38 g) and females (26 g) (see Figure 2). The average intakes of potassium and calcium also fell below the AI amounts, but folate intake met the RDA of 400 mcg (or µg) (see Figure 2). The average intake of cholesterol equaled approximately the recommended daily amount for adults (300 mg), but was over the recommended amount for individuals at increased risk of cardiovascular disease (CVD). Lastly, at 4.1 mcg per day, the average Vitamin D intake lay just below the AI of 5 mcg per day for adults under 50 and far below the AI of 10 mcg per day for adults over 50, who only consumed an average of 4.3 mcg per day. Relative to nonusers, those who used the NFP had a higher intake of vitamin D and lower sodium intake (see Figures 2 and 3).

Figures 6 and 7 illustrate the slight differences in macro-nutrient intake and diet composition between users and nonusers. Compared to nonusers, users consume a greater share of their daily energy intake (kcals) from protein and less from alcohol (ethanol). Figure 8 shows that individuals who use the NFP, health claims, ingredient list, or serving size information (i.e., food labels in general) had a greater likelihood of having hypertension, diabetes, and high total cholesterol or hypercholesterolemia.[7] However, those who used food label had a lower probability of having low HDL, i.e,"good," cholesterol levels.[8,9]

4. Empirical Strategy

Individuals who report using food labels have systematically different characteristics than those who do not report using labels and these differences will likely affect their dietary patterns. That is, a simple linear regression of the effect of using food labels on nutrient intake may suffer from selection bias. This section outlines the econometric model and identification strategy I use in this study to overcome the selection bias issue and estimate the effect of food label use on nutrient intake.

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[7]Hypertension diagnosed if systolic pressure $\geq$ 140 mm Hg, diastolic pressure $\geq$ 90 mm Hg, or previous diagnosis. Hypercholesterolemia diagnosed if total cholesterol $\geq$ 240 mg/dL or individual reported previous diagnosis.

[8]Low HDL diagnosed if $\leq$ 50 mg/dL for women and $\leq$ 40 mg/dL for men.

[9]The recommended daily allowances and adequate intake information come from Gropper, Smith, and Groff (2009) and McGrundy (1998).

4.1 Instrumental Variables Model

NHANES contains several different measures of food label and dietary guidance use. I estimate the effect of using the Nutrition Facts panel (NFP), the ingredient list, and dietary guidance as measured by the use of a MyPyramid food guide plan (USE_i, in general) on nutrient intake given by

$$NUT_{i,j} = \alpha_j USE_i + \mathbf{X}_i \beta_j + \varepsilon_{i,j}, \tag{1}$$

where the vector $\mathbf{X}_i$ contains information on age, gender, race, martial status, household income, education, health conditions, physical activity, smoking, alcohol consumption, FAFH consumption, self perceived diet quality, and vegetarianism. Certain individuals (e.g., women and dieters) tend to under-report calorie intake and energy intake tends to increase on the weekend (Briefel et al. 1997). Therefore, I include indicators for whether that days intake was (i) unusually hi, (ii) unusually high, (iii) collected on a Friday, Saturday, or Sunday. I also include an indicator that equals one if the respondent was surveyed between November and April and zero otherwise. These indicators, together with the controls for individual characteristics, should capture the majority of the bias in self repotted dietary intake. I acknowledge that respondent may also misreport use of food labels and dietary guidance, but unfortunately I cannot identify which respondents misreport label use or what characteristics are associated with misreporting.

In the first stage the outcomes (nutrient intakes) I evaluate include daily consumption of kcal; the calorie surplus; the percentage of kcal from total fat, saturated fat, poly-unsaturated fatty acids (PUFA), mono-unsaturated fatty acids (MUFA), carbohydrate, and protein; the percentage of carbohydrates from sugar; and daily consumption of ω-3 fatty acid (FA), ω-6

FA, sodium, potassium, calcium, cholesterol, iron, and folate.[10,11] With the exception of the calorie surplus measure, the *Dietary Guidelines for American's, 2010* identified these macro- and micro-nutrients as measures of diet quality and healthfulness (USDA and DHHS 2010).

4.2 Identification

A valid instrument will strongly predict the use of food labels and only affect nutrient intake in so far as it affects the use of food labels. That is, a valid instrument can be excluded from the nutrient equation and the model achieve identification. Thus, the label use equation must contain at least one regressor not contained in the nutrient intake equation, where

$$USE_i = \mathbf{Z}_i\gamma + \upsilon_i, \tag{2}$$

As suggested by Angrist and Pischke (2009, p. 191), I use the predicted probability of using the respective food label or dietary guidance from a probit model given by

$$USE_i^{NL} = \Phi(\mathbf{X}_i\beta + \delta FGP_i + \lambda\mathbf{FA}_i + \mu EYE_i + \nu_i), \tag{3}$$

as the instrument. In Equation (3) FGP_i is an indictor for having heard of the USDA Food Guide Pyramid, the vector $\mathbf{FA}_i$ represents a set of indicators for self reported allergies to fish, shellfish, soy, peanuts, other nuts, and other allergies, and EYE_i indicates that the respondent had difficulty reading ordinary newsprint or seeing items on a crowded shelf. The IV model given by (1) and (2) is just-identified, with one excluded exogenous ($\widehat{USE_i^{NL}}$) and one included endogenous variable (USE_i) and assumes that the instruments in the label use equation are uncorrelated with the errors in the nutrient intake equation, $\varepsilon_{i,j}$ and strongly

[10]I calculate the calorie surplus variable as $CS_i = KCAL_i - BMR_i = KCAL_i - 9.8 \times WT_i$, where WT_i represents the measured body weight (in pounds) of individual i, $KCAL_i$ represents the average daily kilocalorie intake for the two 24-hour dietary recall surveys, and BMR_i represents the basal metabolic rate. The BMR of an individual equals the amount of energy used per day sustaining life and maintaing normal bodily function (Sherwood 2007, pp. 633–636). Therefore, the calorie surplus measure indicates how many kcal individual i would have to burn per day to maintain a body weight of WT_i (Christiansen et al. 2005).

[11]I calculate and use the two-day average intake for each nutrient if the respondent completed two 24-hour dietary recall questionnaires and the one day intake if not.

correlated with food label use, USE_i (Cameron and Trivedi 2005, pp. 99–100). I estimate the model described by Equations (1)–(2) using the `svy: ivregress` commands in STATA se 12.

I assume that an individual with a specific self-reported food allergy would have a greater probability of using the information on a food label, but that the perceived food allergy would only affect the dietary patterns and nutrient intake of the individual by stimulating the use of food labels. A greater number of individuals perceive that they have a food allergy than actually do. The primary strategy for managing a food allergy is to avoid the "causal food" by repeatedly and thoroughly reading food labels and ingredient lists (Munõz-Furlong and Sampson 2008; Sicherer and Sampson 2012).[12] I found that self reported allergies to wheat, eggs, milk, and corn significantly affected nutrient intake (e.g., individuals with milk allergies consumed significantly less dietary calcium, all else equal) and therefore I omit these specific food allergies from Equation (3).

Similarly, I assume that knowing about or having heard of the USDA Food Guide Pyramid affects nutrient intake and dietary patterns only by affecting the use of food labels or nutrition guidance (i.e., one of the MyPyramid meal plans). Also, I assume that having difficulty reading ordinary newsprint or seeing items on a crowded shelf affect nutrient intake only in so far as they affect food label use. As suggested by Lin and Lee (2004), I include the measures of nutrition importance and perceived diet quality as regressors in both the selection and outcome models (i.e., in both $\mathbf{X}_i$ and $\mathbf{Z}_i$) because perceptions about food labels may affect both nutrient intake and label use and cannot be excluded from (1).

I evaluate the strength of these instruments using a Hausman test with the null hypothesis that food label is exogenous to nutrient intake and that the ordinary least squares (OLS) estimate of the effect of label use (α_j^{OLS}) is consistent and efficient. Rejecting the null hy-

[12] The Food Allergen Labeling and Consumer Protection Act (FALCPA) of 2004, which went into effect on January 1st, 2006, helps consumers to identify possible allergens in food products. The Act gave FDA the authority to require that manufacturers declare allergens from the eight most common food allergens or in, or next to, the ingredient list and in plain nontechnical language (Vierk et al. 2007).

pothesis implies that α_j^{OLS} is inconsistent and that, given valid instruments, the IV estimate (α_j^{IV}) is consistent.[13]

5. Results

This section describes the characteristics associated with the use of several different types of food labels. I also present and discuss the estimated effect of using food labels and dietary guidance on nutrient intake. I include a description of the possible health benefits associated with changes in the intake of specific nutrients. Lastly, I evaluate the model and the resulting estimates using several diagnostic measures and tests.

5.1 Determinants of Food Label Use

Appendix table A2 displays the marginal effects from the estimation of Equation (2), describing the determinants of food label and dietary guidance use. Awareness or knowledge of the USDA Food Guide Pyramid significantly increased the probability of an individual using the NFP, ingredient lists, serving size information, and a MyPyramid meal plan. For example, knowing about the Food Guide Pyramid increased the probability of using the NFP, ingredient lists, and a MyPyramid plan by 13.2%, 7.9%, and 13.1%, respectively.[14] Consistent with the previous literature I find that women have a greater propensity to use food labels. Having a college degree, and potentially higher cognitive abilities, significantly increased the probability of using the NFP and ingredients lists, but did not affect the use of health claims, serving size information or the MyPyramid meal plan. The fact that the NFP and ingredient lists involve more reading and arithmetic may explain this result (Cohen and Babey 2012).

[13] I test for endogeneity by estimating the augmented OLS regression: $NUT_{i,j} = \alpha_j USE_i + \mathbf{X}_i \beta_j + \gamma_j \widehat{USE}_i + \varepsilon_{i,j}$, and test $H_o : \gamma = 0$ versus $H_a : \gamma \neq 0$ (Cameron and Trivedi 2005, pp. 275–276).

[14] All marginal effects calculated at the means of the independent variables.

The share of food expenditure on FAFH did not significantly affect the probability of using ingredient lists. Individuals who reported that they took nutrition into account when purchasing food had a significantly higher probability of using all six types of food and menu labels, confirming the hypothesis that individuals seek information consonant with their actions. Smokers had a significantly lower probability of using food labels, but individuals who participated in vigorous leisure time physical activity (LTPA) had a greater probability of using the NFP and serving size information. Interestingly, individuals who perceived themselves to have excellent or very good diets had only a slightly greater likelihood of using ingredient lists. Individuals who thought they had food allergies had a 15.1% greater probability of using the ingredient list, as we might expect.

Appendix Table A3 contains the marginal effects from the estimation of Equation (2), describing the determinants of restaurant menu label exposure and willingness to use. Knowing about the Food Guide Pyramid (FGP) significantly increased willingness to use restaurant menu labels. Not surprisingly, eating out more often significantly increased exposure to menu labeling. The share of food expenditure on FAFH significantly affected exposure to restaurant labels and willingness to use them, but not food label use, suggesting that individuals might use food labels on FAFH differently and for different reasons than they use labels on food-at-home (FAH) items. The link test suggests the the models of exposure to fast-food menu labeling and intent to use sit-down menu labeling suffer from omitted variables or model mispecification issues.

5.2 Effects of Using the Nutrition Facts Panel

Columns 1 and 2 of Table 2 contain the results of the OLS and IV estimation of the model described by (1) and (2) where $USE_i = 1$ if the individual reported using the NFP always, most of the time, or sometimes. The Hausman test results imply inconsistency in $\widehat{\alpha_j^{OLS}}$ for the share of kcals from saturated and total fat at the $\alpha = 0.05$ level (denoted with a superscript a), therefore I prefer the IV estimates for these two nutrients. The estimated IV coefficients on NFP use on these nutrients are statistically significant at the 10% level. Recall that $\mathbf{X}_i$ contains many behaviors and characteristics (e.g., smoking, physical activity, and alcohol consumption), therefore the estimated effect of using the NFP is independent of the effects of these other health behaviors.

I find that compared to nonusers, individuals who use the NFP consume 120 fewer kcals per day and have a 167 kcal lower calorie surplus per day.[15] The difference in the intake of total kcal translates to a difference in steady state weight of 14.3 pounds for a moderately active individual or an 18.0 pound difference for a sedentary individual using the model by Christiansen et al. (2005).[16][17] While compared to nonusers NFP users do not have a significantly lower average body weight, the results suggest that they may have had a higher body weight had they not used the NFP. That is, it appears that individuals may use the NFP to regulate caloric intake. Given that the model controls for the level of physical activity, we can interpret the calorie surplus measure as "metabolically unnecessary" kcals, i.e., energy not used to sustain life or fuel daily physical activities. Alternatively, 120 kcals per day is roughly equivalent to 10 ounces of regular cola (slightly less than one can), or 11 potato chips. In the context of food portions, one may more easily see how a difference in 120 kcals per day between users and non users could occur.

The slight reduction in ω-3 intake associated with using the NFP is mildly concerning. The estimated coefficient translates to a 6 percent ($= \frac{0.094}{1.65}$) decrease in the average intake of ω-3 in the sample. Omega-3 FA intake has several health benefits including anti-

[15] When I let $USE_i = 1$ only if the individual reported using the NFP always, the estimated effect equals -135.1 kcals per day, suggesting this effect is not skewed by the effect of "always" users and that the estimated effect is robust to different definitions or degrees of label use.

[16] I use the formula for the change in steady state weight for a given change in energy intake derived from the parameters in Christiansen et al. (2005) assuming a moderately active individual has a physical activity factor (PAF) of 1.5 and a sedentary individual has a PAF of 1.2. The formula equals $\Delta W_{SS} = \frac{\Delta EC_{\text{kcal/day}}}{\alpha \text{PAF}}$, where $\alpha = 6.07$. However, this model of the dynamics of body weight does not account for the effects of diet composition on changes in body weight, which are not negligible.

[17] The model presented by Hall et al. (2009) predicts a slightly lower change in steady state weight of 11.3 pounds for a 120 kcal increase in daily caloric intake.

inflammatory, triglyceride reducing, and anti-thrommbogenic (anti-clotting) effects (Kris-Etherton, Harris, and Appel 2002). ω-3 and ω-6 FA are both types of PUFA.[18] However, Americans do not consume enough ω-3 relative to ω-6 FA, which acts as a pro-inflammitory agent (Simopoulos 2002). NFP users also consume statistically—but not nutritionally—significantly more daily kcals from protein than non users.

[**Table 2.** Estimated Effect of Food Label and Dietary Guidance Use on Nutrient Intake]

5.3 Effects of Using Health Claims

Columns 3 and 4 of Table 2 contain the results of the OLS and IV estimation of the model where $USE_i = 1$ if the individual reported using label health claims always, most of the time, or sometimes. The Hausman test results imply inconsistency in $\widehat{\alpha_j^{OLS}}$ for the share of kcals from PUFA at the $\alpha = 0.05$ level, therefore I prefer the IV estimate.

I find that health claim users consumed significantly more fiber and calories from carbohydrate, which may suggest higher intake of complex carbohydrates from whole-grains, legumes, or vegetables. Diets high in fiber may help regulate blood sugar, reduce cholesterol, increase satiety, and reduce the incidence of some chronic illnesses, including cardiovascular disease (CVD) (Gropper, Smith, and Groff 2009, pp. 118–119).

I also find that label health claim users consumed a slightly higher portion of total calories from protein.[19] Since the average share of total kcals from protein in the sample equals 16 percent, the effect of using health claims probably has an negligible, and certainly not detrimental, effect on overall health.

[18] The ω-6 FA linoleic acid (18:2(ω-6)) and the ω-3 FA α-linolenic acid (18:3(ω-3)) are essential because the human body cannot synthesize them. Plant foods contain the two essential FA and must be included in the diet (Gropper, Smith, and Groff 2009, pp.133–134).

[19] Proteins, and the amino acids that comprise them, are essential elements of the diet used to build tissues, facilitate the absorption of nutrients from the intestine, and protect against infection, among many other functions (Gropper, Smith, and Groff 2009, pp. 179–181). The upper bound on the recommended percent of daily kcals from protein equals 30 percent (Gropper, Smith, and Groff 2009, p. 240).

The estimated effect of label use on cholesterol intake translates to an 7.5 percent ($= \frac{22.40}{300.16}$) decrease in the average intake of dietary cholesterol in the sample. For some individuals dietary cholesterol intake significantly affects serum cholesterol (hypersensitive individuals), and thus, CVD risk (Gropper, Smith, and Groff 2009, pp.154–155). This implies that using the health claims will benefit those who have a hypersensitivity to dietary cholesterol while leaving hyposensitive individuals no worse off.

In sum, these effects generally imply that individuals who use label health claims have a relatively healthier diet than nonusers. Using label health claims may help reduce CVD risk by increasing fiber intake, while reducing total kcal, cholesterol, and saturated fat intake. This may not come as a surprise considering the fact that FDA has approved several health claims related to the intake of fiber, saturated fat, cholesterol and CVD risk (Gropper, Smith, and Groff 2009, pp. 118–119, 154–155).[20]

5.4 Effects of Using Ingredient Lists

Columns 5 and 6 of Table 2 contain the results of the OLS and IV estimation of the model where $USE_i = 1$ if the individual reported using the ingredient list always, most of the time, or sometimes. The Hausman test results imply inconsistency in $\widehat{\alpha_j^{OLS}}$ for iron and the share of daily kcals from protein at the $\alpha = 0.05$ level, therefore I prefer the IV estimates for these two nutrients.

I find that using the ingredient list significantly increased fiber intake (by 1.04 g or 6.5%). The increased fiber intake associated with using the health claims and ingredient list may be especially beneficial because ingredient list users had a greater probability of having hypercholesterolemia, but a (slightly) lower probability of having low HDL cholesterol.

[20]For a full list of qualified health claims and health claims meeting significant scientific agreement see: www.fda.gov/Food/LabelingNutrition/LabelClaims/default.htm.

5.5 Effects of Using Serving Size

Columns 7 and 8 of Table 2 contain the results of the OLS and IV estimation of the model where $USE_i = 1$ if the individual reported using the serving size information always, most of the time, or sometimes. The Hausman test results do not imply inconsistency in $\widehat{\alpha_j^{OLS}}$ for any of the nutrients, therefore I prefer the OLS estimates for all nutrients.

I find that those who use the serving size information consumed significantly lower total kcal (128.5 kcal), calorie surplus (116.5 kcal), dietary cholesterol, and ω-6 FA. They also consume a significantly greater share of total kcals from protein. I discussed the benefits associated with these nutrients in the previous sections. The difference in total daily kcal and calorie surplus translate to a 15.5 pound and 14.1 pound difference in steady-state weight for an average individual.[21]

5.6 Effects of MyPyramid Meal Plan Use

Columns 9 and 10 of Table 2 contais the results of the OLS and IV estimation of the model where $USE_i = 1$ if the individual reported using a MyPyramid meal plan. The Hausman test results imply inconsistency in $\widehat{\alpha_j^{OLS}}$ for the share of total kcals from PUFA, intake of ω-6 FA, and total daily kcals, therefore I prefer the IV estimates for these nutrients.

I find that using a MyPyramid meal plan significantly increases the intake of potassium, folate, iron, fiber, ω-6 FA and the percent of kcal from carbohydrate and PUFA. I discussed the concerns with increasing ω-6 intake relative to ω-3 intake in the previous sections. Using a MyPyramid plan reduced the average daily intake of dietary cholesterol by 15.7 mg (5%) and increased intake of iron, potassium, and fiber by 7.2%, 5.8%, and 12.5%, respectively.[22] Those who use the MyPyramid plan may especially benefit from increased potassium intake

[21] See footnote 13.

[22] Iron plays a critical role in human metabolism and iron deficiency, the most common cause of anemia, is the second most prevalent nutrient deficiency in the United States (Fairbanks 1998; Gropper, Smith, and Groff 2009, p. 485). Diets high in potassium reduce blood pressure, especially for hypertensive individuals and individuals who consume large amounts of sodium (Gropper, Smith, and Groff 2009, pp. 454–458).

because they had a greater probability of having hypertension (see Figure 7). The increased potassium intake associated with using a MyPyramid meal may reduce hypertension and risk of CVD (Keenan and Rosendorf 2011).

The Hausman test suggests inconsistency in the OLS estimated effect (17.25 kcals per day) of using the MyPyramid meal plan on total daily kcals. The IV estimated effect (421.8 kcals per day) is only statistically significant at the $\alpha = 0.10$ level of confidence.

5.7 Model Evaluation

Table 3 contains the first stage F-statistics for using the NFP, health claims, ingredient list, serving size information, or a MyPyramid food plan. For all five first-stage models the instrument $\widehat{USE}^{NL}$ and the total first-stage F-statistics satisfy the criteria that F $\geq$ 10.

[**Table 3.** IV first-stage F-statistics and t-statistics for predicted instrument]

6. Discussion and conclusion

Obesity prevention and treatment policies aim to provide consumers with the tools and resources to prevent weight gain by increasing time spent in physical activity and encouraging individuals to choose healthier foods. FDA safeguards consumers from misinformation by insuring that the Nutrition Facts panel, restaurant menu labels, and labeling statements (including health claims) provide consumers with science-based nutrition information that they can use to make healthy food choices. In this study I attempt to determine whether using food labels and dietary guidance changes consumers dietary choices and thus, nutrient intake. Kim, Nayga, and Capps (2000), Kim, Nayga, and Capps (2001) and Variyam (2008) have presented the most compelling evidence on the effect of food labeling on diet and nutrient intake. Kim, Nayga, and Capps (2000) found that label users consumed less total fat, saturated fat, and cholesterol and more fiber than they would without the using food label.

One of the limitations of this study is that I consider the use of each food label type in isolation when in fact many individuals use more than one type of food label or use food labels in combination with dietary guidance. I have not attempted to measure the effects of this combined use. It is unlikely that the effects are additive. Also, several new food labeling regulations will go into effect over the course of the next few years, e.g., making restaurant menu labeling more ubiquitous, and these new and augmented regulations will likely have different effects than the current set of regulations. The set of environmental or contextual factors that affect food choices in the home and in restaurants differ significantly. Future research should investigate the effects of restaurant menu labeling on consumption patterns.

Using the 2007-2008 NHANES I modeled the determinants of food label and dietary guidance use and estimated the effect of using food labels and dietary guidance on the intake of 18 different nutrients. I control for selection bias in the use of food labels using instrumental variables estimation. Certain types of individuals use food and menu labels and dietary guidance. Women, individuals with more education, food allergies, who think it is important to consider nutrition when making food choices, who engage in vigorous physical activity, or who follow a special diet have a greater probability of using the NFP. Conversely, people who participate in other unhealthy behaviors like smoking and excessive alcohol consumption have a lower likelihood of using the NFP or a MyPyramid food plan. This implies that individual who practice "healthy" lifestyle behaviors, who may consider themselves "healthy," and who may have better cognitive and decision making skills, have a greater probability of using the nutrition information provided on food labels and in dietary guidance. The biggest policy challenge lies in getting people to adopt healthy lifestyle habits and to perceive themselves as "healthy" people, increasing the probability that they put in the effort necessary to utilize the information provided in food labels and dietary guidance.

I find the the NFP is associated with the consumption of 120 fewer kcals per day, or roughly one can of regular soda. The results also suggest a significant and beneficial effect of using health claims, ingredient lists, and serving size information on CVD risk by increasing fiber intake and the share of calories from PUFA while decreasing the intake of cholesterol and saturated fat. Finally, I find that using a MyPyramid meal plan increased the intake of folate, potassium, fiber, iron and the percent of calories from carbohydrate and PUFA (from increased ω-6 FA intake), while decreasing average daily intake of cholesterol. I do not find that using any of the food labels or dietary guidance reduced consumption of sodium for label users.

In general, the evidence suggests that using the information provided on food labels and in dietary guidance improves the dietary patterns of individuals who utilize these resources. Individuals who use food labels and dietary guidance may have better managed body weights and a lower risk of hypertension and CVD from the effects of label use on nutrient intake. For individuals that have already developed chronic health conditions like type 2 diabetes and hypertension, food labels and dietary guidance provide the information they need to better manage their conditions and improve their health.

This research provides evidence that the food labels FDA regulates and the dietary guidance USDA provides help consumers make healthier choices and that they have the potential to help those who do not use these tools yet. Consumers have more and better nutrition information available to them than ever before, but the amount of effort needed to process and utilize that information, especially when individuals do not perceive themselves as the type of people that use nutrition information and food labels, probably reduces the use of these tools. Unfortunately, it appears that many individuals only use these tools and information once they have developed diet-related diseases that necessitate changes in diet and lifestyle. Policy makers should take these observations into consideration when designing food labeling regulation and nutrition education targeted at nonusers.

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8. Tables and Figures

Table 1a. Summary Statistics: Individual Characteristics

	Mean	S.D.
Age	42.21	0.46
# alcoholic drinks per day	2.71	0.32
FAFH (meals per week)	4.23	0.15
Income-to-poverty ratio	3.10	0.10
Waist circumference (cm), women	94.80	0.55
Waist circumference (cm), men	99.92	0.50
Weight (lbs), women	168.29	1.24
Weight (lbs), men	195.62	1.31
	%	
Female	50.14	0.01
Black	11.69	0.02
Mexican American	8.73	0.02
Other race	10.05	0.02
Married	62.73	0.02
High school graduate	24.62	0.01
College graduate	25.86	0.02
Type 2 diabetes	6.80	0.01
Metabolic syndrome	58.41	0.01
Smoker	23.99	0.02
Vigorous LTPA	28.78	0.02
Expenditure on FAFH	26.60	0.87
Frequent shopper	59.64	0.01
Vegetarian	1.83	0.00
Preparer	57.51	0.01
Food allergy	10.20	0.01
Shopper	57.25	0.01
Special diet	13.46	0.01
Family member special diet	22.71	0.01
Self reported excellent or very good diet	30.47	0.01
Nutrition important	48.35	0.02
Difficulty reading newsprint	2.60	0.002
Difficult finding object on crowded shelf	0.64	0.001
Interview in English	93.99	0.01
Observations	4,068	

Note: All statistics calculated using the survey weights provided in NHANES.

Table 1b. Summary Statistics: Food Label & Dietary Guidance

	Mean	S.D.
	%	
Know Food Guide Pyramid	25.15	0.01
Use NFP	61.24	0.02
Use health claims	50.04	0.01
Use MyPyramid plan	18.72	0.01
Use ingredient list	50.12	0.02
Use serving size	49.52	0.01
Seen menu label: fast-food	16.10	0.01
Used menu label: fast-food	6.38	0.00
Seen menu label: sit-down	12.41	0.01
Used menu label: sit-down	6.53	0.01
Would use fast-food menu label	53.71	0.01
Would use sit-down restaurant menu label	52.21	0.02
Observations	4,068	

Note: All statistics calculated using the survey weights provided in NHANES.

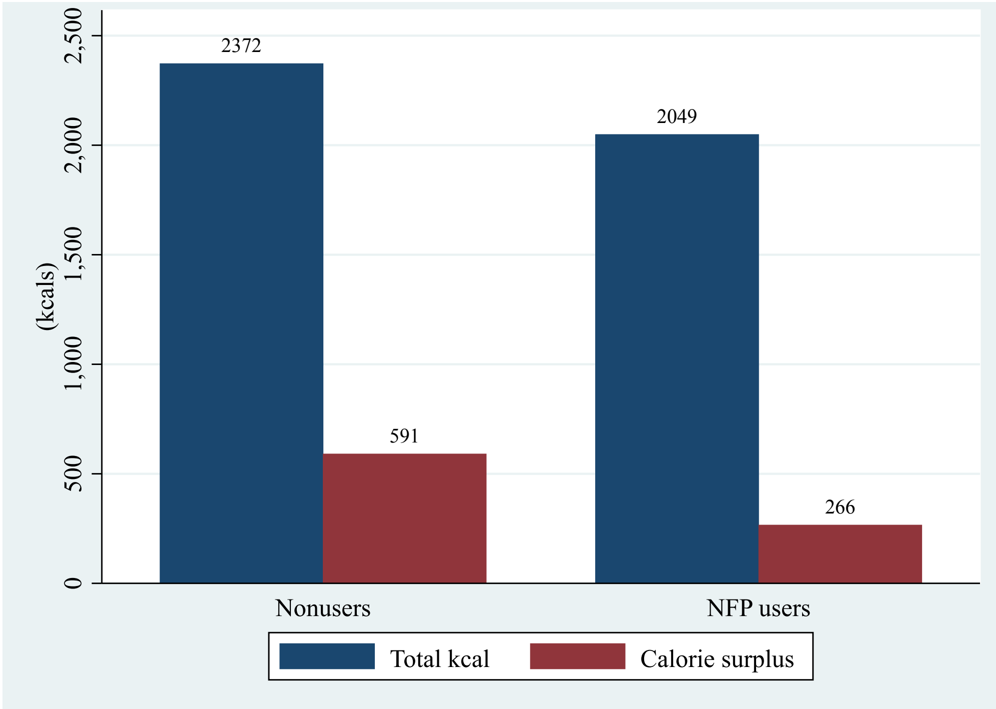

Figure 1: Energy Intake by Nutrition Facts Label Use

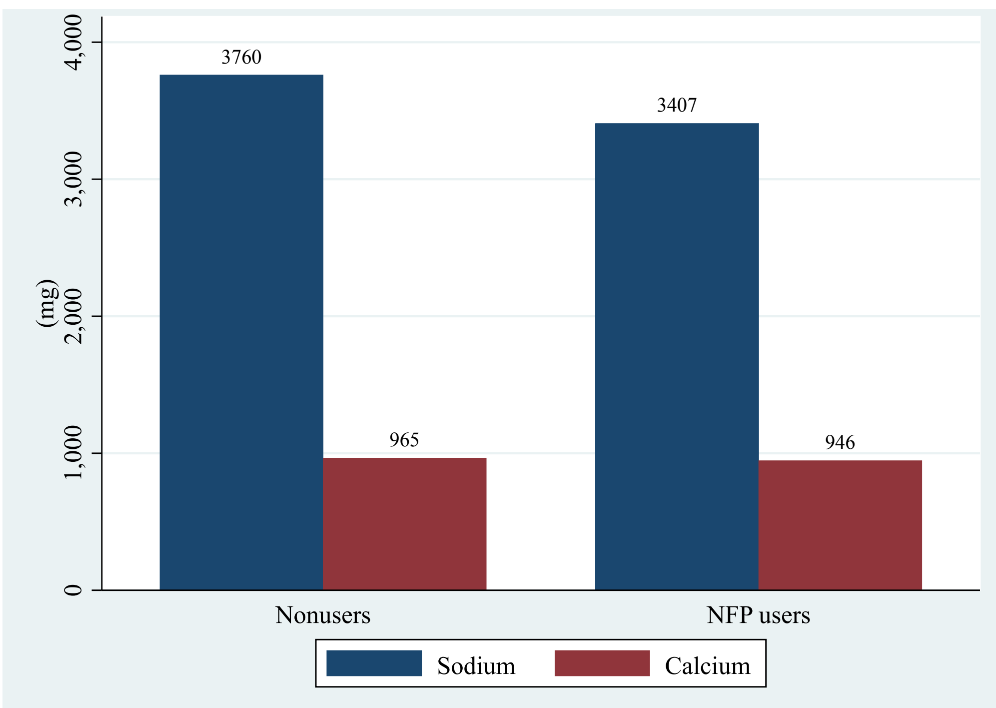

Figure 2: Calcium and Sodium Intake by Nutrition Facts Label Use

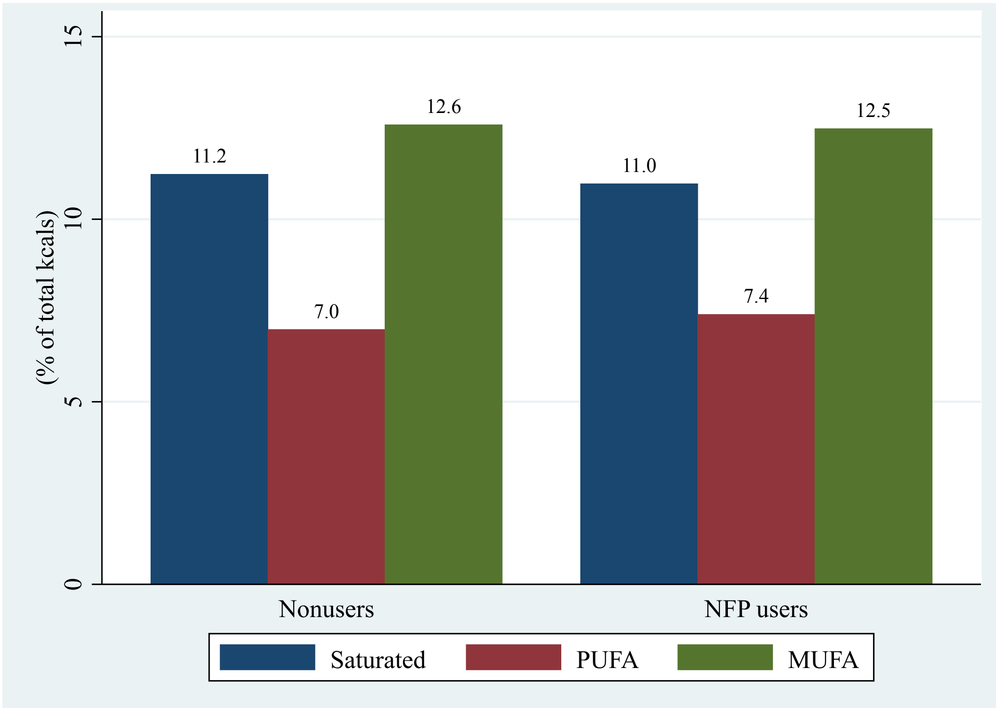

Figure 3: Fat Intake by Nutrition Facts Label Use

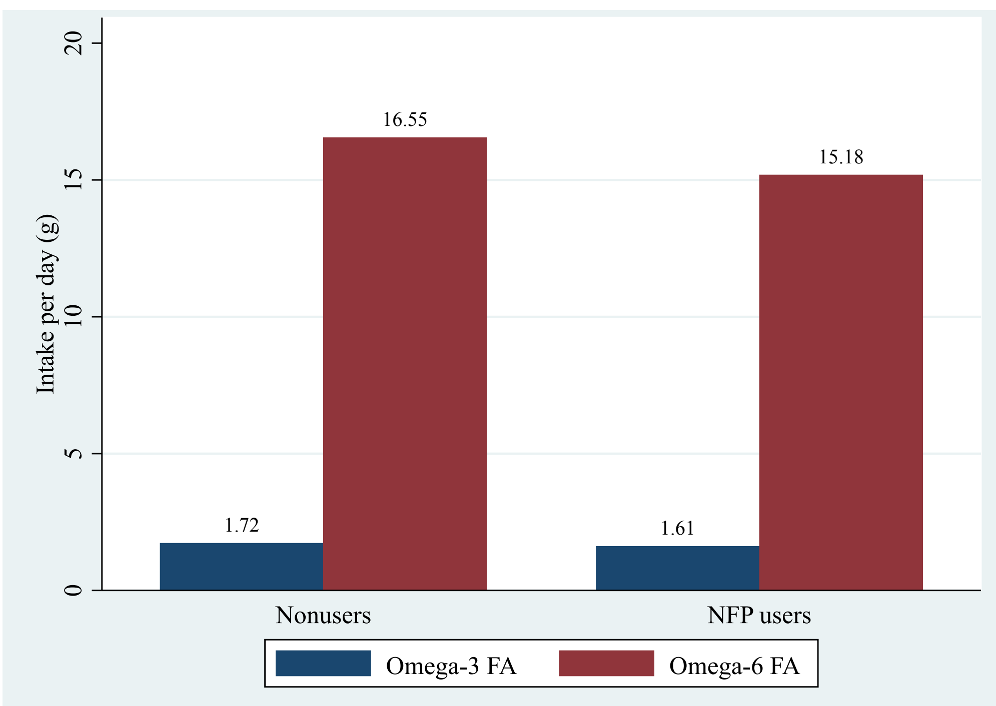

Figure 4: ω-3 and ω-6 FA Intake by Nutrition Facts Label Use

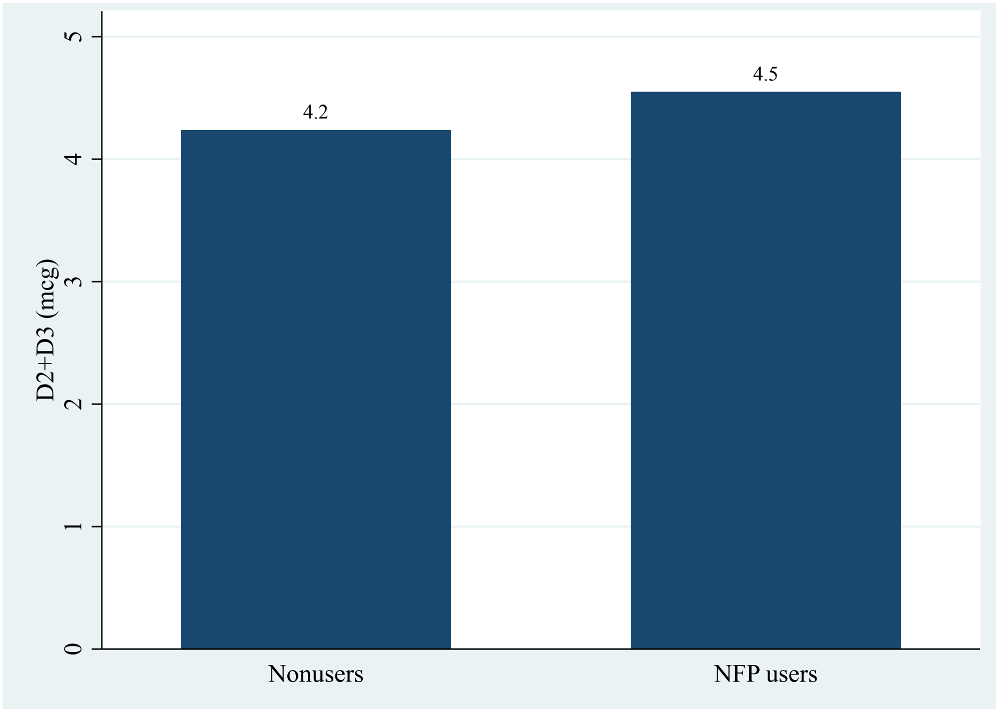

Figure 5: Vitamin D Intake by Nutrition Facts Label Use

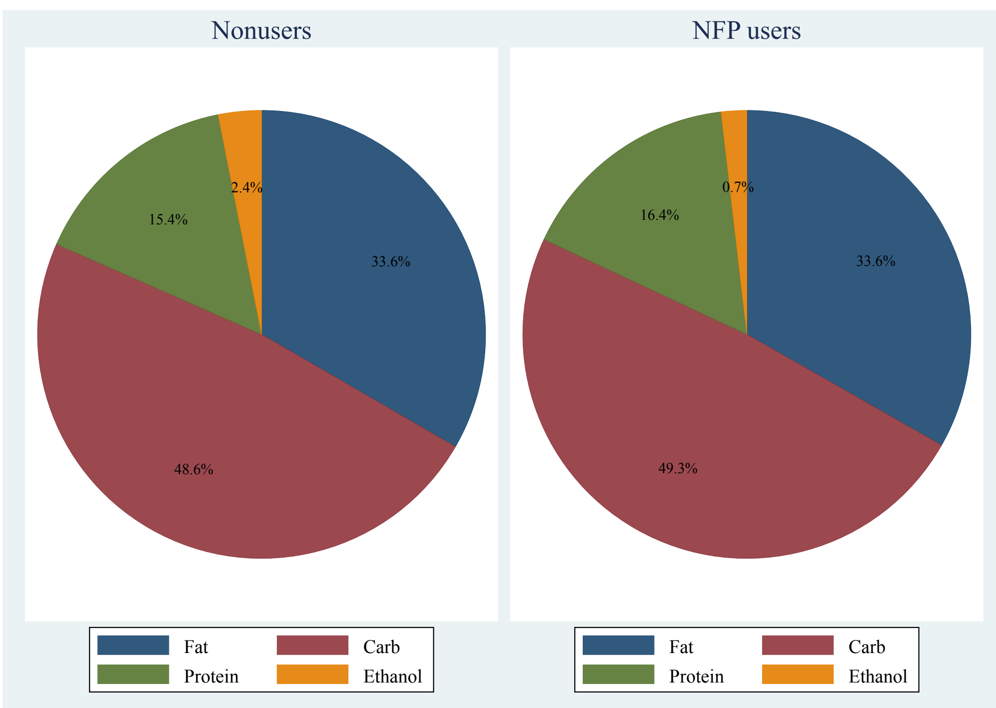

Figure 6: Diet Composition by Nutrition Facts Label Use

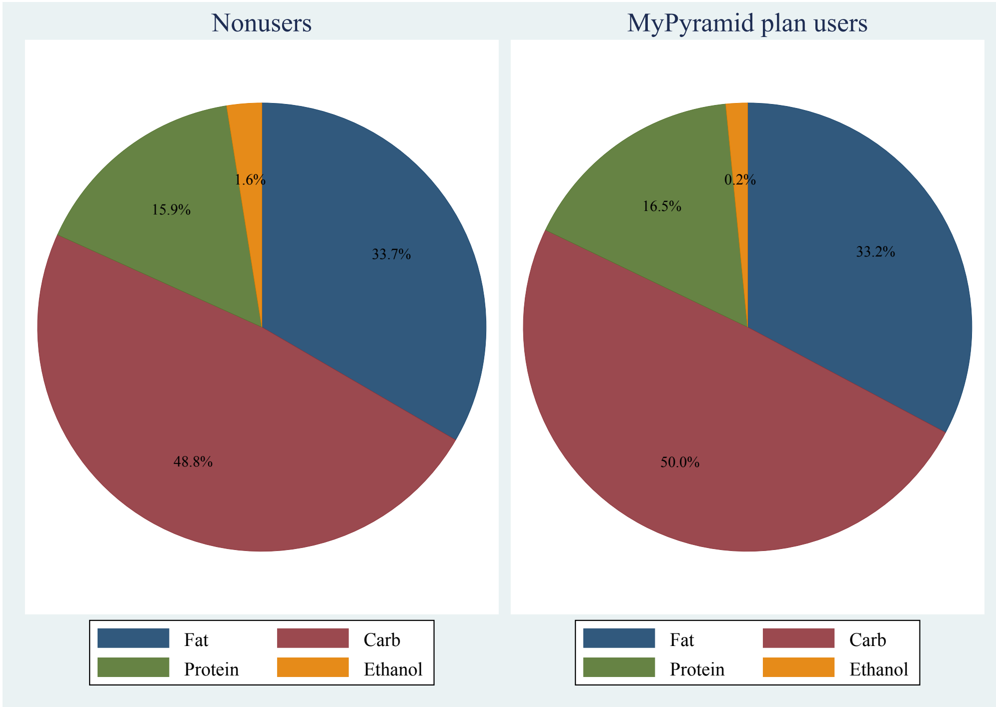

Figure 7: Diet Composition by MyPyramid Meal Plan Use

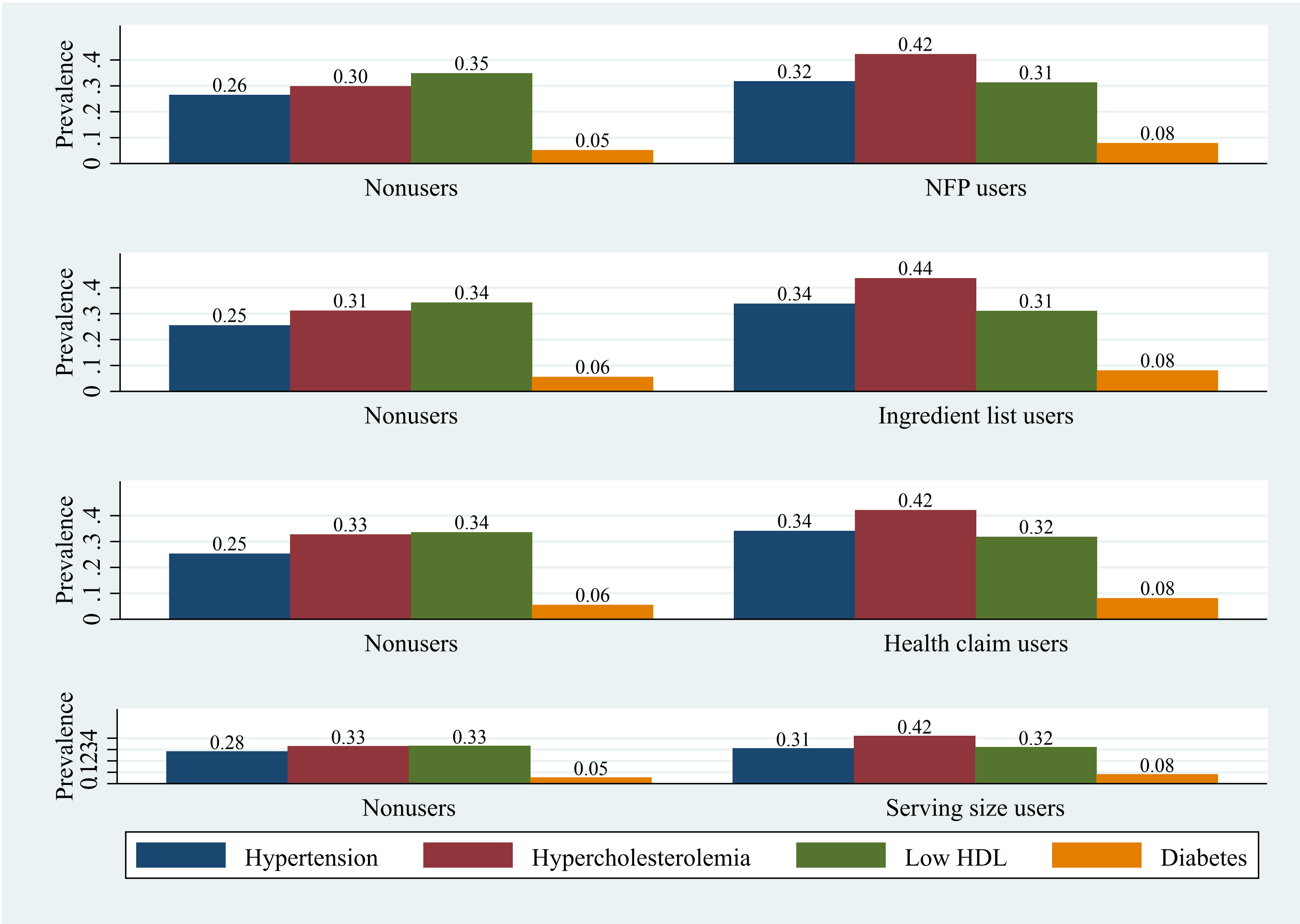

Figure 8: Health Conditions by Food Label Use

Table 2. Estimated Effect of Food Label and Dietary Guidance Use on Nutrient Intake

	Coefficient on use of:									
	NFP		Health claims		Ingredient list		Serving size		MyPyramid Plan	
Nutrient:	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV
Vitamin D (mcg)	0.004	0.29	0.051	3.29	-0.15	0.75	-0.25	1.96	0.19	0.79
Sodium (mg)	-69.77	122.70	-38.04	439.7	-53.44	735.4	-87.52	1,046	-7.167	780.7*
Folate (mcg)	3.37	81.38	2.52^{a}	229.2*	14.01	145.8*	-10.68	266.0	26.76†	88.41
Potassium (mg)	-39.62	-230.40	33.46	524.2	19.59	310.6	-64.67	97.20	156.4‡	344.6
Iron (mg)	0.29	2.70	0.31	6.57	0.49^{a}	5.87*	-0.29	7.538	1.137‡	3.85
Calcium (mg)	-8.73	125.50	10.13	254.5	13.90	41.82	-30.10	222.4	35.18*	103.0
Cholesterol (mg)	-18.68*	-30.70	-22.40†	7.33	-8.18	33.40	-25.64‡	-36.90	-15.74†	30.39
Fiber (g)	0.47	-0.76	0.79†	6.15	1.04‡	1.60	-0.11	4.24	1.97‡	2.86
% MUFA	-0.06	1.40	-0.25*	0.49	-0.054	0.33	-0.10	1.57	-0.37†	0.336
% PUFA	0.15	0.54	-0.04^{a}	2.95*	0.13	1.67*	0.11	3.20†	0.20$^{\dagger a}$	1.465†
% kcal sat fat	-0.21^{a}	1.86*	-0.40‡	-0.47	-0.024	-0.87	-0.12	0.30	-0.42‡	-0.317
% kcal total fat	-0.19^{a}	3.90*	-0.73†	3.27	0.07	1.19	-0.13	5.18	-0.61†	1.52
Omega-3 (g)	-0.09†	-0.11	-0.05	0.78	-0.01	0.21	-0.05^{a}	0.75	0.03	0.38
Omega-6 (g)	-0.39	0.47	-0.48	8.33	0.05	5.21	-0.77†	6.89	0.44^{a}	5.01†
% kcal protein	0.37†	0.14	0.42†	-1.54	0.002	0.06	0.59‡	0.16	0.26	0.10
% kcal carb	0.87*	-2.38	1.20†	5.61	0.57	0.44	-0.04	-0.29	1.0†	3.28†
Total kcal	-119.9‡	-74.46	-61.60*	500	-29.85	404.4	-128.5‡	296.8	17.25^{a}	421.8*
Calorie surplus	-167.0‡	-400.5	-73.02*	203.1	-28.06	175.0	-116.5†	-90.24	-35.41	320.6

Note: ‡ $p < 0.01$, † $p < 0.05$, * $p < 0.1$. (*a*) Reject the Hausman test with H_o :*all variables exogenous* at $\alpha = 0.05$.
All models estimated with adjustments for the complex survey design and weighting scheme of NHANES.

Table 3. IV first-stage F-statistics and t-statistics for predicted instrument

	Food label or dietary guidance type:				
	Nutrition Facts panel	Health claims	Ingredient list	Serving size	MyPyramid meal plan
			F-statistic		
Total first-stage	81.5	17.0	53.9	23.5	161.89
$\widehat{USE}_i^{NL}$	88.2	13.8	33.2	14.6	105.3
			t-statistic		
Know FGP	4.9	1.8	2.7	2.2	9.1
Food allergy:					
Fish	-0.8	-1.5	-2.2	-0.2	-0.2
Shellfish	-0.3	0.1	2.0	0.2	3.5
Peanut	1.0	3.21	3.5	0.03	2.1
Other nut	-0.4	-0.6	2.4	-0.4	-1.0
Soy	-0.2	-1.3	-2.1	-0.4	–
Other	2.2	0.2	1.3	0.9	0.2
Vision problems[a]	-3.7	-1.7	-1.6	-2.8	-2.4

Notes: (*a*) Difficulty reading newsprint or seeing items on a crowded shelf.

9. Appendix

Table A1. Summary Statistics: Nutrients

	Mean	S.D.
Total kcal	2,174.26	21.98
Calorie surplus	391.82	20.47
% kcal from total fat	33.62	0.22
% kcal from saturated fat	11.07	0.10
% kcal from PUFA	7.23	0.05
% kcal from MUFA	12.52	0.09
% kcal from carbohydrates	49.03	0.39
% of carbohydrates from sugar	44.32	0.47
% kcal from protein	15.99	0.12
ω-3 (g)	1.65	0.03
EPA+DHA (g)	0.13	0.007
ω-6 (g)	15.72	0.22
ω-3:ω-6	0.11	0.001
Fiber (g)	16.13	0.40
Sodium (mg)	3,543.96	41.44
Calcium (mg)	952.91	19.85
Potassium (mg)	2,668.55	39.80
Folic acid (mcg)	200.96	5.06
Folate (mcg)	416.52	9.62
Cholesterol (mg)	300.16	4.98
Iron (mg)	15.72	0.29
Vitamin D (D2 + D3, mcg)	4.43	0.12
Observations	4,068	

Note: All statistics calculated using the survey weights provided in NHANES.

Table A2. Food Label and Dietary Guidance Use, Marginal Effects

	NFP (1)	Health Claims (2)	Ingredient list (3)	Serving size (4)	MyPyramid Plan (5)
Know Food Guide Pyramid	0.132‡	0.0324	0.0788†	0.0619†	0.131‡
	(0.0249)	(0.0193)	(0.0305)	(0.0279)	(0.0139)
Shopper	-0.00978	-0.0464*	-0.0404	0.0315	0.0241
	(0.0345)	(0.0233)	(0.0406)	(0.0296)	(0.0159)
Preparer	0.0550*	0.0180	0.0554	-0.0338	0.0193
	(0.0308)	(0.0230)	(0.0361)	(0.0294)	(0.0137)
Food allergy	0.0559	0.0473	0.151‡	0.0336	0.0460
	(0.0321)	(0.0430)	(0.0235)	(0.0287)	(0.0397)
Difficult to see plain text	-0.0929*	-0.0615	-0.0439	-0.0882*	-0.0349
	(0.0458)	(0.0578)	(0.0491)	(0.0428)	(0.0223)
Difficult to see crowded shelf	-0.287†	-0.0461	-0.137	-0.174	-0.0656
	(0.109)	(0.111)	(0.116)	(0.107)	(0.0611)
Family size	-0.0106*	-0.00928	-0.0103	-0.00505	0.0129†
	(0.00513)	(0.00870)	(0.00819)	(0.00741)	(0.00558)
Age	0.00507‡	0.00479‡	0.00826‡	0.00535‡	0.000722
	(0.000779)	(0.000960)	(0.000955)	(0.000932)	(0.000489)
Age-mean(Age)$\hat{2}$	9.01e-06	6.04e-05	-1.53e-05	-3.53e-05	1.25e-05
	(5.44e-05)	(5.50e-05)	(5.67e-05)	(5.79e-05)	(4.77e-05)
Female	0.130‡	0.108‡	0.0615‡	0.143‡	0.0848‡
	(0.0158)	(0.0229)	(0.0174)	(0.0220)	(0.0171)
Black	-0.123‡	-0.0242	-0.00553	0.00867	-0.0226
	(0.0260)	(0.0176)	(0.0341)	(0.0210)	(0.0155)
Mexican American	-0.0985‡	-0.0413	-0.0177	-0.0142	-0.0122
	(0.0199)	(0.0433)	(0.0326)	(0.0281)	(0.0189)
Other race	-0.0815†	-0.0602	-0.00201	-0.0561	-0.0565‡
	(0.0366)	(0.0421)	(0.0481)	(0.0341)	(0.0159)
Married	0.0508	0.0415	-0.0115	0.00524	-0.0273
	(0.0292)	(0.0261)	(0.0234)	(0.0268)	(0.0192)
Income-to-poverty ratio	-0.000426	-0.0125	-0.00929	-0.0114	0.00304
	(0.00645)	(0.00777)	(0.00680)	(0.00663)	(0.00526)

Note: All marginal effects evaluated at the mean. Standard errors in parentheses,
‡ $p<0.01$, † $p<0.05$, * $p<0.10$.

Table A2 (continued). Food Label and Dietary Guidance Use, Marginal Effects

	NFP (1)	Health Claims (2)	Ingredient list (3)	Serving size (4)	MyPyramid Plan (5)
High school graduate	-0.00264	0.0172	-0.0167	0.0228	-0.0145
	(0.0180)	(0.0268)	(0.0243)	(0.0212)	(0.0143)
College graduate	$0.106^{‡}$	0.00829	0.0580*	0.0342	0.0338
	(0.0204)	(0.0336)	(0.0308)	(0.0297)	(0.0235)
Type 2 diabetes	0.0485*	0.0314	-0.00948	0.0452	0.0337
	(0.0260)	(0.0366)	(0.0408)	(0.0419)	(0.0339)
Metabolic syndrome	-0.0326*	-0.0134	-0.0144	-0.00127	0.0169
	(0.0185)	(0.0229)	(0.0200)	(0.0176)	(0.0124)
Current smoker	$-0.128^{‡}$	$-0.131^{‡}$	$-0.0550^{†}$	$-0.0894^{‡}$	$-0.0476^{†}$
	(0.0253)	(0.0339)	(0.0252)	(0.0228)	(0.0173)
# alcoholic drinks per day	-8.70e-05	-0.000313	-0.000259	-0.000150	-0.00724*
	(0.000261)	(0.000355)	(0.000287)	(0.000257)	(0.00367)
FAFH	0.00152	-0.00415	-0.00374	0.00332	-0.00298
	(0.00247)	(0.00250)	(0.00289)	(0.00282)	(0.00182)
Vigrous LTPA	$0.0775^{‡}$	0.0304	0.0255	0.0584*	-0.0117
	(0.0217)	(0.0264)	(0.0383)	(0.0301)	(0.0163)
% expenditure on FAFH	0.00211	0.00176	0.000223	0.00199	0.00102
	(0.00189)	(0.00196)	(0.00205)	(0.00206)	(0.00104)
(% expenditure on FAFH)^2	-3.78e-05	-2.34e-05	-2.05e-05	-1.96e-05	-1.59e-05
	(2.43e-05)	(3.13e-05)	(3.10e-05)	(3.00e-05)	(1.56e-05)
Special diet	$0.0921^{‡}$	0.0168	0.0314	0.0496	0.00742
	(0.0273)	(0.0434)	(0.0359)	(0.0296)	(0.0200)
Family member special diet	$0.0552^{†}$	0.00304	0.00281	0.0433	0.0187
	(0.0243)	(0.0260)	(0.0315)	(0.0272)	(0.0190)
Nutrition important	$0.413^{‡}$	$0.371^{‡}$	$0.418^{‡}$	$0.355^{‡}$	$0.166^{‡}$
	(0.0189)	(0.0179)	(0.0246)	(0.0175)	(0.0135)
Excellent or very good diet	0.00662	-0.0174	0.0395*	-0.0304	0.0222
	(0.0301)	(0.0149)	(0.0204)	(0.0315)	(0.0160)
Interview in English	0.0345	-0.0458	0.0122	-0.0505*	0.0356*
	(0.0225)	(0.0308)	(0.0398)	(0.0289)	(0.0182)
Link test t-stat	-0.04	-0.29	-0.09	-3.64	-0.54

Note: All marginal effects evaluated at the mean. Standard errors in parentheses, ‡ $p<0.01$, † $p<0.05$, * $p<0.10$.

Table A3. Restaurant Menu Label Use, Marginal Effects

	Seen menu label at:		Would use menu label at:	
	Fast-food	Sit-down	Fast-food	Sit-down
	(1)	(2)	(3)	(4)
Know Food Guide Pyramid	-0.0258*	-0.0125	0.115‡	0.114‡
	(0.0125)	(0.0164)	(0.0206)	(0.0178)
Shopper	0.00138	0.0160	-0.00466	-0.0238
	(0.0261)	(0.0210)	(0.0306)	(0.0269)
Preparer	-0.00425	0.00177	-0.00284	0.0347
	(0.0224)	(0.0211)	(0.0285)	(0.0312)
Food allergy	-0.000424	-0.00269	0.0474	0.0263
	(0.0231)	(0.0175)	(0.0443)	(0.0311)
Difficult to see plain text	-0.0378	-0.0343	-0.137‡	-0.112†
	(0.0298)	(0.0246)	(0.0427)	(0.0389)
Difficult to see crowded shelf	-0.0816	-0.0880‡	0.0485	-0.205*
	(0.0537)	(0.0224)	(0.0875)	(0.104)
Family size	-0.00100	0.00248	-0.00831	-0.0146*
	(0.00537)	(0.00506)	(0.00631)	(0.00826)
Age	-0.000782	0.000133	8.90e-05	0.00163
	(0.000615)	(0.000363)	(0.00102)	(0.000961)
Age-mean(Age)$\hat{2}$	-6.57e-05‡	-1.70e-05	-0.000147†	-2.94e-05
	(2.03e-05)	(2.99e-05)	(5.58e-05)	(4.14e-05)
Female	0.0137	0.0393†	0.146‡	0.162‡
	(0.0220)	(0.0154)	(0.0224)	(0.0194)
Black	-0.0318‡	0.0251	-0.0417†	-0.0693†
	(0.00860)	(0.0197)	(0.0187)	(0.0263)
Mexican American	-0.0506‡	-0.00351	-0.0983†	-0.0377
	(0.0134)	(0.0229)	(0.0357)	(0.0298)
Other race	-0.0903‡	-0.0214	-0.121‡	-0.0858*
	(0.0143)	(0.0167)	(0.0313)	(0.0410)
Married	-0.00458	-0.00702	0.0382	0.0664†
	(0.0154)	(0.0102)	(0.0289)	(0.0231)
High school graduate	-0.0489†	0.00154	0.0297	0.00995
	(0.0199)	(0.0152)	(0.0210)	(0.0190)
College graduate	0.00539	0.00611	0.0268	0.0173
	(0.0122)	(0.0157)	(0.0311)	(0.0262)

Note: All marginal effects evaluated at the mean. Standard errors in parentheses, ‡ $p<0.01$, † $p<0.05$, * $p<0.10$.

Table A3 (continued). Restaurant Menu Label Use, Marginal Effects

	Seen menu label at:		Would use menu label at:	
	Fast-food	Sit-down	Fast-food	Sit-down
	(1)	(2)	(3)	(4)
Income-to-poverty ratio	-0.00288	0.00782*	0.00246	0.0206*
	(0.00495)	(0.00414)	(0.00841)	(0.0105)
Type 2 diabetes	0.0395	-0.00561	-0.0383	-0.0434
	(0.0342)	(0.0214)	(0.0430)	(0.0410)
Metabolic syndrome	0.0178	0.00470	-0.00776	-0.0501†
	(0.0190)	(0.0126)	(0.0216)	(0.0187)
Current smoker	-0.0284*	-0.0222	-0.0490†	-0.0623†
	(0.0162)	(0.0181)	(0.0189)	(0.0249)
# alcoholic drinks per day	-0.000510	-0.000179	0.000134	-0.00253
	(0.00109)	(0.000103)	(0.000190)	(0.00330)
FAFH	0.000511	-0.000892	0.00506†	0.00395*
	(0.00192)	(0.00121)	(0.00195)	(0.00224)
Vigorous LTPA	0.0195	0.0176	0.0204	0.0669‡
	(0.0173)	(0.0173)	(0.0165)	(0.0175)
% expenditure on FAFH	0.00290*	0.00244†	0.00478†	0.00381†
	(0.00143)	(0.000939)	(0.00188)	(0.00149)
(% expenditure on FAFH)2̂	-1.98e-05	-3.58e-05†	-5.37e-05†	-3.32e-05*
	(1.75e-05)	(1.24e-05)	(2.13e-05)	(1.89e-05)
Special diet	-0.0382	-0.0290*	0.0240	0.0249
	(0.0245)	(0.0151)	(0.0238)	(0.0303)
Family member special diet	0.0252*	0.00907	0.0665‡	0.0791‡
	(0.0140)	(0.0258)	(0.0202)	(0.0196)
Nutrition important	0.0873‡	0.0505‡	0.339‡	0.353‡
	(0.0134)	(0.0132)	(0.0212)	(0.0181)
Excellent or very good diet	-0.0106	-0.0108	-0.0286	-0.0169
	(0.0118)	(0.0152)	(0.0275)	(0.0245)
Interview in English	0.0798‡	0.0849‡	0.0426	0.0640†
	(0.0147)	(0.0134)	(0.0305)	(0.0292)
Link test t-stat	2.84	0.68	-1.41	5.45

Note: All marginal effects evaluated at the mean. Standard errors in parentheses, ‡ $p<0.01$, † $p<0.05$, * $p<0.10$.