DOES NUTRITIONAL LABEL USE AFFECT BODY MASS INDEX?

A Thesis
submitted to the Faculty of the
Graduate School of Arts and Sciences
of Georgetown University
in partial fulfillment of the requirements for the
degree of
Master of Public Policy
in Public Policy

By

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Washington, DC
April 12, 2012
Does Nutritional Label Use Affect Body Mass Index?

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ABSTRACT

The Nutritional Labeling and Educational Act of 1990 requires the disclosure of the nutritional content of packaged foods sold in stores on a standardized label and grants the Food and Drug Administration (FDA) the authority to regulate the presence of health and nutrient content claims. Specific nutrients including calories, calories from fat, saturated fat, and sugars are required to be listed on a nutritional label.

Many assume that knowledge about the calorie content of foods will motivate or guide individuals to consume the appropriate amount of calories for proper weight management, thereby mitigating the obesity epidemic in the United States. Although studies have shown that nutritional labels can influence consumer decisions, the theory that nutritional labels can actually help Americans maintain a healthy body weight lacks evidence.

Recently, there have been concerted efforts to extend nutritional labeling to other types of food items and to provide more visible, front-of-package information to consumers. With potentially hundreds of millions of taxpayer and private sector dollars committed to new nutritional label standards on a wide-range of food products, it is worthwhile to take a closer look at the relationship between nutritional labels and obesity.

Applying multivariate regression analysis to data from the 2005-2006 National Health and Nutrition Examination Survey (NHANES), this study finds that, controlling for other factors,
individuals who use nutritional labels have a higher body mass index (BMI) and are more likely to be obese than those who do not use labels. The results of this study provide no evidence that label use helps individuals maintain a non-obese weight, calling into question the common assumption that nutritional labels are an effective weight management tool.
The research and writing of this thesis is dedicated to everyone who helped along the way, especially Harriet Komisar, my tireless advisor whose guidance has been invaluable.

Mom and Dad – Thank you for your constant love and support, and for always encouraging me to “find a way or make one.”

ERICA L. GORDON
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INTRODUCTION

Obesity is a growing health concern in the United States. The U.S. has the highest prevalence of obesity among adults and children internationally; more than one-third of U.S. adults (over 72 million people) and 17 percent of U.S. children are obese (Rutkow et al., 2008; CDC, 2011).

Medical evidence has shown that poor diets can lead to the onset of chronic diseases, leading to increased morbidity, reduced quality of life and premature mortality. Heart disease, cancer and stroke are the top three causes of death in the U.S. and are often associated with diets that are high in calories, total fat, saturated fat, and cholesterol, or that are too low in fiber (Variyam, 1999). In 2008, overall medical care costs related to obesity for U.S. adults were estimated to be as high as $147 billion. In the same year, people who were obese had average medical costs that were $1,429 higher than the cost for people of normal body weight (CDC, 2011). Obesity-related health problems not only lead to higher insurance premiums and more taxpayer dollars devoted to healthcare, they also mean less work time, lost income, lower productivity and earlier retirement (Ulrich, 2005).

Changes in the food environment, including the increase of convenience and fast foods high in fat content, have paralleled the obesity epidemic. One approach to combating obesity, thereby lowering rates of morbidity and mortality as well as overall healthcare costs, is to educate the public about nutrition and the nutritional components of the food that they purchase (Arsenault, 2010).

The Nutritional Labeling and Educational Act (NLEA) of 1990 (Public Law 101-535), which was implemented in 1994, requires the disclosure of the nutritional content of packaged
foods sold in stores on a standardized label and grants the Food and Drug Administration (FDA) the authority to regulate the presence of health and nutrient content claims. Specific nutrients including calories, calories from fat, saturated fat, and sugars are required to be listed. A subsequent 2003 regulation required that trans fat content also be included on nutritional labels.

Prior to the NLEA’s enactment, food manufacturers provided nutritional information only on a voluntary basis. Now, however, consumers have the ability to make informed nutrition and health decisions about their food purchases. The assumption is that knowledge about the calorie content of foods will help individuals consume the appropriate amount of calories for proper weight management, thereby reducing rates of obesity (Arsenault, 2010).

More recently, there have been concerted efforts to extend nutritional labeling to other types of food items and to provide more visible, front-of-package information to consumers. Several states, including California, Maine, Massachusetts, Oregon, New Jersey and Tennessee, have already enacted menu-labeling legislation. Section 4205 of the Patient Protection and Affordable Care Act (PPACA) of 2010 (Public Law 111–148) requires restaurants and similar retail food establishments with 20 or more locations to list calorie content information for standard menu items on restaurant menus and menu boards, including drive-through menu boards. The PPACA also requires vending machine operators who own or operate 20 or more vending machines to disclose calorie content for certain items. Section 4205 became effective on the date the law was signed, March 23, 2010; however, some provisions depend on the FDA to issue rules before they can be required.

Although studies have shown that nutritional labels can influence dietary decisions, evidence indicating that nutritional label use can help Americans maintain a healthy body weight
is lacking. This paper will examine the correlation between nutritional label use and body mass index among adults while controlling for other characteristics, using the 2005-2006 National Health and Nutrition Examination Survey (NHANES). With potentially hundreds of millions of taxpayer and private sector dollars committed to new nutritional label standards on a wide-range of food products, it is worthwhile to take a closer look at the relationship between the use of nutritional labels and obesity.
LITERATURE REVIEW

Although there has been some work on the causes of obesity and the effect of nutritional labeling on diets, few studies have examined the relationship between nutritional label use and measures of weight status, such as body mass index (BMI). The following sections review the existing literature that pertains to 1) the relationship between nutritional label use, diet and consumer behavior, and 2) the relationship between nutritional label use and measures of weight status, such as BMI and obesity.

NUTRITIONAL LABEL IMPACT ON DIET AND CONSUMER BEHAVIOR

According to the Centers for Disease Control and Prevention (CDC), “overweight” refers to adults whose BMI, a number calculated using weight and height measurements, is between 25 and 29.9. “Obese” refers to adults whose BMI is 30 or higher. Diets high in trans fats, sugar, and salt, combined with lack of exercise are contributing causes of obesity (Ulrich, 2005). Studies have shown that better awareness of fat- and cholesterol-related health problems and better attitudes about avoiding too much fat and cholesterol are associated with significant reductions in the intakes of these nutrients (Variyam, 1999).

A survey in Washington State found that belief in the importance of a low-fat diet and knowledge of the association between diet and cancer strongly predicted food label use, and that food label use was significantly associated with lower fat intake (Neuhouser et al., 1999). According to the 2008 Health and Diet Survey conducted by the FDA, 49 percent of consumers reported changing their minds about purchasing a product based on reading the nutrition label. These studies provide evidence that nutrition knowledge and usage of labels can impact an individual’s nutrient intake and food choices.
A 2006 study compares the change in body weight of individuals who used labels in their food selection in the periods before and after the NLEA’s implementation with the change in body weight over the same period of individuals who did not use labels (Variyam and Cawley, 2006). Using data from the 2000 National Health Interview Survey, the study found that while label users gained less BMI than nonusers over the 7 year time period, the difference was statistically significant only among non-Hispanic white women. The study estimated that obesity prevalence among non-Hispanic white women was 2.7 percentage points lower than it would have been without the new labels. The label effect was not statistically significant for most of the other examined race and gender groups; an exception was for black men, among whom label-users had a higher weight gain than those who did not use labels.

A similar 2009 study also evaluates the impact of nutritional label use on body weight (Drichoutis et al., 2009). Using the 2005-2006 NHANES dataset and a propensity score matching technique to assess the effect of each level of label use, the researchers found that nutritional label use did not have an effect on BMI.

While both the Variyam and Cawley (2006) and Drichoutis and colleagues (2009) papers yield interesting results and provide a solid foundation for further research in the area of nutritional labeling and obesity, neither study fully accounts for food consumed away from home. Research shows that meals and snacks based on food prepared away from home contain more calories per eating occasion, and “away” food was higher in total fat and saturated fat on a per-calorie basis than at-home food (Guthrie et al., 2002). While the paper by Drichoutis and colleagues does include a single variable to control for number of meals per week not prepared at home.
home, there are many other factors associated with non-labeled foods, aside from just the amount consumed, that must be considered. Additionally, neither study controls for exercise or physical activity, another important factor that has been proven to help maintain a healthy BMI. Those who read food labels and add regular, vigorous physical activity to their regimes may show an increased probability of weight loss.
**CONCEPTUAL FRAMEWORK AND HYPOTHESIS**

Using nutritional labels may help individuals maintain a healthy body weight, but there are several other key factors that may also influence weight. As evidenced by the literature on nutrition and obesity, there are five major categories that must be accounted for when considering BMI: individual characteristics, family characteristics, health condition and habits, dietary knowledge and attitudes including use of nutritional labels, and consumption of non-labeled food.

**INDIVIDUAL CHARACTERISTICS**

Individual physical characteristics including age, sex, race and ethnicity may all influence BMI. Males generally have a higher BMI than females, younger people may be more likely to have a lower BMI than older people, and some ethnicities may be more prone to obesity than others. In addition to physical characteristics, it is also important to consider educational background. Individuals with a higher level of education may be more informed about health and nutrition and therefore more likely to have a lower BMI than less educated individuals.

**FAMILY CHARACTERISTICS**

Whether or not an individual is married and has children may also impact BMI. A person living with a spouse and several children likely has different eating habits than someone who is single and prepares food only for himself. Income may also be a factor; those with higher levels of income may be able to afford higher quality, more nutritious foods. Foods that are energy dense like oil, margarine and sugars, are relatively inexpensive per calorie. One study estimates that healthy foods, such as fresh fruits, vegetables, and lean meats increase a food budget by 5,000 percent per calorie (Ulrich, 2005). Studies have also shown that food label use is
associated with improved dietary quality among all income groups with a greater benefit among higher income individuals. Income is not associated with improved dietary quality in the absence of food label use (Perez-Escamilla and Haldeman, 2001). Additionally, an individual’s geographic location should be considered, as some areas may have better access to healthier foods.

**HEALTH CONDITION AND HABITS**

Whether an individual is diabetic or has a chronic illness should be taken into account, as there is strong evidence of a relationship between obesity and increased risk of cardiovascular disease, diabetes, cancer and dementia (Mandal, 2010). Conversely, these health conditions can also play a role in determining an individual’s BMI and increase the probability of obesity. It is also important to consider individual habits that may influence health, including how often an individual exercises, consumes alcohol, uses illegal drugs, or smokes cigarettes.

**DIETARY KNOWLEDGE, ATTITUDES, AND NUTRITIONAL LABEL USE**

An individual’s dietary knowledge, including their understanding of calories and the food guide pyramid, could also play a role in determining BMI. Attitude toward health and diet may also be a factor; those who place a high importance on nutrition may be more likely to have a lower BMI than those who do not value nutrition or those who believe that some people are simply “born to be fat.” Furthermore, those who believe they are following a healthy diet may have a lower BMI than those who would characterize their diet as poor or unhealthy.

Nutritional labels exist to guide consumer decisions and help individuals make healthy food choices. For food labeling to impact consumers’ health and weight status, consumers must be able to read the label, understand and know how to use it, and then make decisions about food
consumption based on that information. The hypothesis that this study examines is that those who use food labels will be better able to maintain a healthy body weight than those who do not use labels.

CONSUMPTION OF NON-LABELED FOODS

While an individual may frequently use nutritional labels when deciding what types of grocery store items to purchase, they may also purchase food away from home that is not labeled. Dining out, eating fast foods, or eating unlabeled “ready to eat” foods may all have an impact on BMI. Food purchased outside the home can be higher in calories, poorer in nutritional quality, and served in larger portions, which promotes overconsumption (Roberto et al., 2010).

Individual characteristics, family characteristics, health condition and status, dietary knowledge and attitudes, and consumption of non-labeled foods may all play a role in influencing BMI. Holding these factors constant, this study examines the hypothesis that those who use nutritional labels will have a lower BMI and will be less likely to be obese than those who do not use nutritional labels.
**DATA AND METHODS**

In order to more closely examine the relationship between nutritional label use and BMI, this study will utilize the 2005-2006 National Health and Nutrition Examination Survey (NHANES). NHANES is a project of the National Center for Health Statistics within the Centers for Disease Control and Prevention (CDC), one of the major operating components of the Department of Health and Human Services. This survey is a combination of interviews conducted in respondents’ homes, which cover demographic, socioeconomic, dietary, and health-related questions; and physical examinations performed in specially-designed and equipped mobile centers, which include medical, dental, and physiological measurements, as well as laboratory tests administered by medical personnel.

NHANES takes a nationally representative sample of approximately 5,000 individuals each year. Surveys are conducted in various counties across the country, 15 of which are visited each year. The sample for the survey is selected to represent the U.S. population of all ages. Participants are selected through a complex statistical process using the most current Census information. NHANES divides the United States into communities and then into neighborhoods. The neighborhoods are selected at random and then housing units from these neighborhoods are selected at random. Selected households are approached by interviewers and asked a few short questions to determine if they are eligible for the study. Participants are selected based on age, gender, and racial/ethnic background.

This study will look at the adult population (ages 18 and older) who have both examination and interview data. While children under the age of 18 may use nutritional labels,
the assumption is that children generally do not purchase groceries, prepare meals or make many of their own nutritional decisions. This study will focus on the direct effect of nutritional label use by adults, as opposed to an indirect effect that may be experienced by children who often do not make their own food choices. Additionally, this study will exclude pregnant women, as their BMI will not be a good indicator of their weight status.

**ANALYSIS PLAN**

In order to examine the relationship between nutritional label use and BMI, while controlling for other factors, this study will use the following ordinary least squares regression model:

- Model 1: \[ \text{BMI} = \beta_0 + \beta_1 \text{Nutritional Label Use} + \beta_2 \text{Individual Characteristics} + \beta_3 \text{Family Characteristics} + \beta_4 \text{Health Conditions and Habits} + \beta_5 \text{Dietary Knowledge and Attitudes} + \beta_6 \text{Consumption of Non-Labeled Foods} + \text{Error} \]

Additionally, this study will use the following linear probability model:

- Model 2: \[ \text{Obese} = \beta_0 + \beta_1 \text{Nutritional Label Use} + \beta_2 \text{Individual Characteristics} + \beta_3 \text{Family Characteristics} + \beta_4 \text{Health Conditions and Habits} + \beta_5 \text{Dietary Knowledge and Attitudes} + \beta_6 \text{Consumption of Non-Labeled Foods} + \text{Error} \]
**DEPENDENT VARIABLE**

BMI is used as the dependent variable in Model 1. BMI, which is calculated by dividing an individual’s weight in kilograms by height in meters squared, is measured by medical personnel during the physical examination portion of the survey.

A binary variable is used as the dependent variable in Model 2: 1 will indicate an individual who is obese, and 0 will indicate an individual who is not obese. Obesity is defined as having a BMI of 30 or higher.

**NUTRITIONAL LABEL USE**

Nutritional label use is the key variable of interest. It is measured during the interview portion of the survey and is posed as the following question: “How often do you use the Nutrition Facts panel when deciding to buy a food product?” If respondents use labels “Always” or “Most of the time,” a binary variable is set equal to 1; it is set equal to 0 if labels are used “Sometimes” or “Rarely,” “Never,” or “Never Seen.”

**INDIVIDUAL CHARACTERISTICS**

Age is a continuous variable measured in years. Individuals’ metabolisms change over time and therefore it is expected that BMI will increase with age.

To control for gender differences in BMI, the models include a binary variable equal to 1 if the respondent is male. It is expected that men will have a higher BMI than women, after controlling for other characteristics.

Race/ethnicity is characterized as Hispanic, Non-Hispanic White, Non-Hispanic Black, and other or Multi-racial. Each race/ethnic category is expressed as its own binary variable.
Education is measured using four categories: “Less than High School,” “High School,” “Some College,” or “College Grad or Above.” Because education may create a better awareness of the costs and benefits of various health habits, increase a person’s ability to obtain health information, and better enable an individual to process or act on that information, higher education is expected to be associated with lower BMI and a lower probability of obesity (Variyam, 1999).

**FAMILY CHARACTERISTICS**

Marital status is measured as “Married,” “Living with partner,” “Divorced, Separated or Widowed,” or “Never Married.” Someone who lives alone is likely to have different eating habits than someone who has a spouse or partner.

Annual household income is measured in dollars and is categorized as less than $25,000, $25,000 to $50,000, $50,000 to $75,000, and more than $75,000. High-income households will likely have better access to high quality, nutritious foods than low-income households, and therefore may have a lower BMI than low-income households.

Family size is measured in number of people living in the household. Food budgets, and quantity and quality of food are usually affected by family size and therefore may have an impact on a family’s diet.

**HEALTH CONDITION AND HABITS**

General health condition was rated by individuals as either “Excellent or Very Good,” “Good,” or “Fair or Poor.” Those who believe their health is “Fair or Poor” might be making certain adjustments in their lifestyle or eating habits to compensate, thereby affecting on their BMI.
This study combined a set of questions regarding alcohol intake to compute, on average, how many times per week an individual consumes alcohol. Answers were categorized as 0, 1 to 2, 3 to 5, 6 to 9, or more than 9 drinks per week. Consumption of alcohol can cause weight gain and can alter an individual’s judgment and eating habits.

Diabetes was reported by individuals and recorded as either “Yes,” they have been told by a doctor they have diabetes, or “No,” they have not been told by a doctor they have diabetes, or “Borderline,” if they have been told they are a borderline diabetic. People with diabetes are typically instructed by doctors to maintain a strict diet and control their sugar intake, which may have a direct impact on BMI. However, diabetes is also often a side effect of obesity.

Drug users were measured by whether an individual had ever used marijuana or hashish; cocaine, heroine, or methamphetamine; or a combination of these two categories of drugs. A binary variable is set equal to 1 if an individual used both categories of drugs in his lifetime; it is set equal to 0 if he has used at least one type or never used drugs. Like alcohol consumption, drug use can alter an individual’s judgment and eating habits, causing weight to fluctuate.

Smoking must also be considered, as it may alter eating patterns thereby impacting BMI. Respondents were asked if they currently smoke cigarettes. A binary variable is used to indicate responses of “Every day” or “Some days,” versus “Not at all.”

Exercise was measured by the following question: “Over the past 30 days, did you do any vigorous activities for at least 10 minutes that caused heavy sweating, or large increases in breathing or heart rate? Some examples are running, lap swimming, aerobics classes or fast bicycling.” Answers were recorded as “Yes,” “No,” or “Unable to do activity” (binary variable
equal to 1 indicates vigorous activity, 0 indicates no activity or unable to do activity). Evidence has shown that exercise is a key ingredient to maintaining a healthy body weight.

**Dietary Knowledge and Attitudes**

How an individual views the quality of his diet can also play a role in determining what type of foods that individual chooses to eat. Answers were categorized as “Excellent or Very Good,” “Good,” or “Fair or Poor.”

Dietary knowledge was gauged with a series of questions on whether the individual has heard of “Dietary Guidelines for Americans,” “The Food Guide Pyramid,” and “The 5-A-Day [for Better Health] Program.” Individuals with strong (heard of all 3 programs) or medium (heard of 1 or 2 programs) dietary knowledge may make different food and lifestyle choices than those with weak dietary knowledge (not heard of any program).

Individuals’ views on whether people can affect if they are overweight or obese was measured by the following question posed by an interviewer: “Would you say you strongly agree, somewhat agree, neither agree nor disagree, somewhat disagree, or strongly disagree with the following statement: Some people are born to be fat and some thin; there is not much you can do to change this.” Individuals who strongly agree or somewhat agree that some people are “born to be fat” are represented by a binary variable equal to 1; this variable equals 0 for those who neither agree nor disagree, somewhat disagree, or strongly disagree. Individuals who believe they may have simply been “born fat” may believe they lack the ability to lose weight.

Respondents were also asked about their consumption of non-labeled food: “On average, how many meals per week do you get that were not prepared at a home?” They were specifically asked to include meals from both dine-in and carry out restaurants, restaurants that deliver food
to your home, cafeterias, fast-food places, food courts, food stands, meals prepared at a grocery store, and meals from vending machines. Some individuals never consume meals not prepared at home or only consume them less than once a week; others eat non-home cooked meals 1-2, 3-5, or 6 or more times a week. Individuals who regularly eat out at restaurants, purchase fast food, or consume pre-prepared processed foods may be more likely to have a higher BMI than individuals who prepare their own food at home.
**RESULTS**

**DESCRIPTIVE STATISTICS**

The sample consists of 3,251 U.S. adults (ages 18 and older) from the 2005-2006 NHANES dataset and is representative of a national adult population. Males make up 49% of the primarily non-Hispanic white (69%) study population (see Table 1). Most individuals have at least a high school education; only 15% did not achieve a high school degree. A majority are also married (58%) or living with a partner (10%).

The results indicated that the mean BMI among U.S. adults is 28.6. About one-third (32%) have a normal BMI (18.5 - 25), 31% are overweight (25.1 - 29.9), and 35% are obese (>=30). Most individuals (56%) acknowledge that some people are not simply “born to be fat”; they believe people have the ability to control or change their weight.

Twenty-eight percent of adults believe they maintain an excellent or very good diet, while 41% reported that they maintain a good diet; 31% describe their diet as fair or poor. Additionally, most believe they are in excellent or very good health (45%) or in good health (34%). Only 6% are diabetic or borderline diabetic. Fifty-eight percent have not done vigorous exercise in the last 30 days.

Thirty-eight percent of individuals use nutritional labels all or most of the time, while conversely, 38% use labels rarely or never; the other 24% reported using labels “sometimes.” Most individuals have at least some dietary knowledge: 48% have heard of 1 or 2 (but not all 3) of the Dietary Guidelines for Americans, the Food Guide Pyramid, or the 5-a-Day Program; and 38% are aware of all 3 programs.
Although most individuals have at least some dietary knowledge and make at least some use of nutritional labels, most also regularly consume non-labeled foods. Thirty-two percent consume 1-2 meals per week that are not prepared at home, and 54% consume 3 or more meals per week not prepared at home. Only 6% report that they never eat meals not prepared at home, and only 8% said they eat non-home prepared foods less than weekly.

Bivariate analysis indicates a few differences in weight outcomes for the various categories of label users (see Table 2). The proportion of people with normal weight was similar for people using labels “most or all” of the time (32%) and those using labels “rarely or never” (33%); interestingly, the proportion was slightly lower for those using labels “sometimes” (30%).

By comparison, the proportion of people who are overweight was similar for people using labels “most or all” of the time (31%) and those using labels “rarely or never” (33%); again, the proportion was slightly lower for those using labels “sometimes” (29%).

Similarly, the proportion of individuals who are obese was similar for people using labels “most or all” of the time (34%) and those using labels “rarely or never” (31%); however, the proportion of obese individuals was higher for those using labels “sometimes” (40%).
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<th>% or Mean of Population (weighted)</th>
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<td>BMI in kg/m$^2$</td>
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<tr>
<td>College Grad or Above</td>
<td>695</td>
<td>21.4 %</td>
<td>27.2 %</td>
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</table>
### Family Characteristics

#### Marital Status
- **Married**: 1,776 (54.6 %), 57.6 %
- **Living with Partner**: 356 (11.0 %), 10.0 %
- **Divorced, Separated or Widowed**: 427 (13.1 %), 13.4 %
- **Never Married**: 692 (21.3 %), 19.0 %

#### Annual Household Income
- **< $25,000**: 757 (23.3 %), 16.5 %
- **$25,000 - $50,000**: 694 (21.4 %), 18.9 %
- **$50,000 - $75,000**: 785 (24.2 %), 26.6 %
- **> $75,000**: 852 (26.2 %), 34.1 %
- **Missing**: 163 (5.0 %), 3.9 %

#### Family Size (mean number of people)
- **Mean**: 3,251 (3.4), 3.2

### Health Condition and Habits

#### General Health Condition
- **Excellent or Very Good Health**: 1,270 (39.1 %), 44.8 %
- **Good Health**: 1,165 (35.8 %), 34.3 %
- **Fair or Poor Health**: 545 (16.8 %), 13.7 %
- **Missing**: 271 (8.3 %), 7.2 %

#### Alcohol Consumption (average number of alcoholic drinks consumed per week)
- **0**: 478 (14.7 %), 13.2 %
- **1-2**: 1,262 (38.8 %), 40.2 %
- **3-5**: 296 (9.1 %), 10.2 %
- **6-9**: 226 (7.0 %), 8.1 %
- **More than 9**: 334 (10.3 %), 12.0 %
- **Missing**: 655 (20.2 %), 16.3 %

#### Diabetic
- **Yes or Borderline**: 220 (6.8 %), 6.3 %
- **No**: 3,031 (93.2 %), 93.8 %

#### Drug User (ever used marijuana or hashish; or used cocaine, heroine or methamphetamine)
- **Used Both Types**: 565 (17.4 %), 20.2 %
- **Used At Least One Type**: 1,075 (33.1 %), 36.2 %
- **Never Used Drugs**: 1,258 (38.7 %), 34.6 %
- **Missing**: 353 (10.9 %), 9.1 %
Smoker
- Every day: 675 (20.8%) 22.9%
- Some days: 147 (4.5%) 4.1%
- Not at all: 2,429 (74.7%) 73.0%

Exercise (vigorous activity for at least 10 minutes in the past 30 days)
- Yes: 1,224 (37.7%) 42.0%
- No: 2,027 (62.4%) 58.0%

Dietary Knowledge and Attitudes

Healthy Diet
- Excellent or Very Good Diet: 866 (26.6%) 28.4%
- Good Diet: 1,291 (39.7%) 40.7%
- Fair or Poor Diet: 1,094 (33.7%) 31.0%

Dietary Knowledge (heard of Dietary Guidelines for Americans, the Food Guide Pyramid, or the 5-a-Day Program)
- Strong (Heard of all 3 programs): 1,044 (32.1%) 38.0%
- Medium (Heard of 1 or 2 programs, but not all 3): 1,542 (47.4%) 47.5%
- Weak (Not heard of any program): 665 (20.5%) 14.5%

Believe Some Are "Born to be Fat"
- Strongly Agree or Somewhat Agree: 1,117 (34.4%) 33.0%
- Neither Agree nor Disagree: 372 (11.4%) 10.8%
- Somewhat or Strongly Disagree: 1,762 (54.2%) 56.2%

Consumption of Non-Labeled Foods

Number of Times per Week Eat Meals Not Prepared at Home
- Never or Less Than 1: 552 (17.0%) 13.9%
- 1-2: 1,116 (34.3%) 32.1%
- 3-5: 912 (28.1%) 29.7%
- 6 or More: 671 (20.6%) 24.4%

Source: Author's analysis of data from the 2005-2006 National Health and Nutrition Examination Survey.
Table 2. Percentage Distribution of Adults among Weight Categories, by Nutritional Label Use

<table>
<thead>
<tr>
<th>BMI</th>
<th>Always or Most of the Time</th>
<th>Sometimes</th>
<th>Never, Rarely or Never Seen</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Unweighted</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Underweight</td>
<td>1.9</td>
<td>1.3</td>
<td>2.0</td>
<td>1.8</td>
</tr>
<tr>
<td>Normal</td>
<td>28.2</td>
<td>27.7</td>
<td>30.9</td>
<td>29.2</td>
</tr>
<tr>
<td>Overweight</td>
<td>33.9</td>
<td>31.6</td>
<td>33.9</td>
<td>33.3</td>
</tr>
<tr>
<td>Obese</td>
<td>36.1</td>
<td>39.4</td>
<td>33.2</td>
<td>35.7</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100</strong></td>
<td><strong>100</strong></td>
<td><strong>100</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

| **Weighted** |               |           |                             |       |
| Underweight  | 2.0            | 1.3       | 2.2                         | 1.9   |
| Normal       | 32.4           | 29.7      | 33.4                        | 32.2  |
| Overweight   | 31.4           | 28.6      | 33.1                        | 31.4  |
| Obese        | 34.2           | 40.5      | 31.3                        | 34.6  |
| **Total**    | **100**        | **100**   | **100**                     | **100** |

Source: Author's analysis of data from the 2005-2006 National Health and Nutrition Examination Survey.
REGRESSION ANALYSIS

In order to examine the relationship between nutritional label use and BMI, two different models were used. The first model looks at the impact of nutritional label use on BMI, while the second uses a binary variable to determine the relationship between label use and obesity.

The results of Model 1 indicate that label use is positively correlated with BMI after controlling for other factors (see Table 3). Holding other characteristics in the model constant, using labels “always” or “most of the time” is associated with a BMI that is 1.13 kg/m$^2$ higher than if labels are used “never” or “rarely.” Similarly, holding all other characteristics constant, individuals who “sometimes” use labels have a BMI that is 1.1 kg/m$^2$ higher than individuals who “rarely” or “never” use labels.

Interestingly, Model 1 also shows that individuals who eat 3 to 5 meals a week that are not prepared at home have a BMI that is 1.1 kg/m$^2$ higher than individuals who eat meals prepared outside the home less than once a week or never, holding all other characteristics constant. However, compared with less than once a week or never, eating 1-2 meals or 6 or meals per week not prepared at home were not found to be statistically significant.

As expected, exercise plays a role in determining BMI. Holding other characteristics constant, people who do not perform vigorous activity for at least 10 minutes over a 30 day period have a BMI that is .96 kg/m$^2$ higher than those who do exercise. Additionally, diabetes also had a large positive relationship to BMI; those who are diabetics or borderline diabetics have a BMI that is 3.85 kg/m$^2$ higher than those who are not. Notably, diabetes has the largest positive relationship to BMI of all the variables analyzed.
Education level also had statistically significant relationship to BMI. Model 1 showed that having less than a high school education was associated with a BMI that was 1.05 kg/m$^2$ higher than those who had a college degree or above. Similarly, having a high school degree or some college was associated with a BMI that was 1.34 kg/m$^2$ higher and 1.16 kg/m$^2$ higher respectively than those who had a college degree or above.

Surprisingly, dietary education did not have the same expected impact on BMI. In fact, those with weak dietary knowledge were found to have a BMI that was 1.38 kg/m$^2$ lower than those with strong dietary knowledge. Also unexpectedly, annual household income did not have a statistically significant relationship to BMI.

Race was found to be statistically significant, however the impact varied by ethnic group. Model 1 indicates that Hispanics have a BMI that is 0.66 kg/m$^2$ lower than non-Hispanic whites, while blacks have a BMI that is 1.31 kg/m$^2$ higher than non-Hispanic whites. Other races or multi-racial individuals show the largest negative impact on BMI, exhibiting a BMI that is 1.53 kg/m$^2$ lower than non-Hispanic whites.

Consistent with Model 1, Model 2 shows that individuals who use nutritional labels are more likely to be obese than individuals who do not use labels (see Table 3). Holding all other characteristics constant, individuals who “always” or “most of the time” use labels are 6.5 percentage points more likely to be obese than individuals who “rarely” or “never” use labels. Similarly, individuals who “sometimes” use labels are 9.6 percentage points more likely to be obese than individuals “rarely” or “never” use labels, holding all other characteristics constant. Interestingly, the results of t-test show that there is a statistically significant difference between
“sometimes” using labels and “always” using labels; those who “sometimes” use labels are more likely to be obese than those who “always” use labels.

Model 2 shows nearly the same significance levels and exhibits comparable magnitudes on almost all of the characteristics examined in Model 1. Diabetes remains the factor with the largest magnitude, showing individuals with the disease to be 20.6 percentage points more likely to be obese than individuals without the disease. Race and ethnicity, education, general health condition, and exercise all remained statistically significant in Model 2 with comparable magnitudes to Model 1. Consumption of non-labeled foods, however, lost some statistical significance in the second model, showing that individuals who eat 3 to 5 meals per week not prepared at home were 5.7 percentage points more likely to be obese than individuals who eat meals prepared outside the home less than once a week or never. Annual household income remained an insignificant factor.

Logit and ordered logit models were also run in addition to Models 1 and 2 to confirm consistency. The logit model indicates that the odds of being obese are 42% higher among people who “always” use labels than among people who “rarely” or “never” use labels, while the odds of being obese are 64% higher among people who “sometimes” use labels compared to people who “rarely” or “never” use labels. The findings from an ordered logit model (with weight categories of obese, overweight, normal and underweight) were comparable, showing similar results to the logit model.
<table>
<thead>
<tr>
<th>Variables</th>
<th>BMI Continuous</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Model 1 Coefficient</td>
<td>P-Value</td>
<td>Model 2 Coefficient</td>
</tr>
<tr>
<td>Nutritional Label Use</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Always or Most of the Time</td>
<td>1.130 **</td>
<td>0.036</td>
<td>0.065 *</td>
</tr>
<tr>
<td>Sometimes</td>
<td>1.105 **</td>
<td>0.015</td>
<td>0.096 **</td>
</tr>
<tr>
<td>Rarely, Never or Never Seen</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Individual Characteristics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age (mean in years)</td>
<td>0.057 ***</td>
<td>0.000</td>
<td>0.003 **</td>
</tr>
<tr>
<td>Sex</td>
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<td></td>
</tr>
<tr>
<td>Male</td>
<td>0.953 **</td>
<td>0.003</td>
<td>0.026</td>
</tr>
<tr>
<td>Female</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Race/Ethnicity</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Hispanic</td>
<td>-0.663 *</td>
<td>0.102</td>
<td>-0.074 **</td>
</tr>
<tr>
<td>Non-Hispanic White</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Non-Hispanic Black</td>
<td>1.306 ***</td>
<td>0.001</td>
<td>0.057 **</td>
</tr>
<tr>
<td>Other Race or Multi-Racial</td>
<td>-1.533 **</td>
<td>0.006</td>
<td>-0.073 **</td>
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<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than High School</td>
<td>1.050 *</td>
<td>0.077</td>
<td>0.079 **</td>
</tr>
<tr>
<td>High School</td>
<td>1.335 ***</td>
<td>0.001</td>
<td>0.094 ***</td>
</tr>
<tr>
<td>Some College</td>
<td>1.163 **</td>
<td>0.021</td>
<td>0.068 **</td>
</tr>
<tr>
<td>College Grad or Above</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Family Characteristics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marital Status</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Living with Partner</td>
<td>-0.506</td>
<td>0.326</td>
<td>-0.040</td>
</tr>
<tr>
<td>Divorced, Separated or Widowed</td>
<td>0.701 *</td>
<td>0.081</td>
<td>0.034</td>
</tr>
<tr>
<td>Never Married</td>
<td>-0.028</td>
<td>0.933</td>
<td>-0.034</td>
</tr>
<tr>
<td>Annual Household Income</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; $25,000</td>
<td>0.373</td>
<td>0.494</td>
<td>0.023</td>
</tr>
<tr>
<td>$25,000 - $50,000</td>
<td>0.011</td>
<td>0.983</td>
<td>0.015</td>
</tr>
<tr>
<td>$50,000 - $75,000</td>
<td>0.541</td>
<td>0.298</td>
<td>0.042</td>
</tr>
<tr>
<td>&gt; $75,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Missing</td>
<td>0.180</td>
<td>0.816</td>
<td>-0.020</td>
</tr>
</tbody>
</table>
Family Size (mean number of people) 0.224 ** 0.028 0.020 ** 0.009

**Health Condition and Habits**

**General Health Condition**

- **Excellent or Very Good Health**
- **Good Health** 1.828 *** 0.000 0.120 *** 0.000
- **Fair or Poor Health** 3.178 *** 0.000 0.186 *** 0.000
- **Missing** 0.536 0.518 0.139 ** 0.043

**Alcohol Consumption (average number of alcoholic drinks consumed per week)**

<table>
<thead>
<tr>
<th>Alcohol Consumption</th>
<th>0</th>
<th>1-2</th>
<th>3-5</th>
<th>6-9</th>
<th>More than 9</th>
<th>Missing</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td>0.525</td>
<td>0.380</td>
<td>0.017</td>
<td>0.660</td>
<td></td>
</tr>
<tr>
<td>1-2</td>
<td></td>
<td>-0.521</td>
<td>0.475</td>
<td>-0.051</td>
<td>0.254</td>
<td></td>
</tr>
<tr>
<td>3-5</td>
<td></td>
<td>-0.985</td>
<td>0.203</td>
<td>-0.027</td>
<td>0.648</td>
<td></td>
</tr>
<tr>
<td>6-9</td>
<td></td>
<td>-1.288 *</td>
<td>0.087</td>
<td>-0.111 *</td>
<td>0.056</td>
<td></td>
</tr>
<tr>
<td>More than 9</td>
<td></td>
<td>-0.321</td>
<td>0.596</td>
<td>-0.033</td>
<td>0.373</td>
<td></td>
</tr>
<tr>
<td>Missing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Diabetic**

- **Yes or Borderline** 3.849 *** 0.000 0.206 *** 0.000
- **No**               |   |       |       |       |             |

**Drug User (ever used marijuana or hashish; or used cocaine, heroine or methamphetamine)**

- **Used Both Types** -0.777 ** 0.041 -0.055 * 0.077
- **Used At Least One Type** -0.068 0.864 -0.015 0.725
- **Never Used Drugs**   |   |       |       |       |             |
- **Missing**            |   | 0.298 | 0.741 | -0.070 | 0.274       |

**Smoker**

- **Every day** -1.807 *** 0.000 -0.107 *** 0.001
- **Some days** -1.919 ** 0.003 -0.124 ** 0.006
- **Not at all**        |   |       |       |       |             |

**Exercise (vigorous activity for at least 10 mins over past 30 days)**

- **Yes**               |   |       |       |       |             |
- **No**                |   | 0.964 ** 0.004 | 0.058 ** 0.020

**Dietary Knowledge and Attitudes**

**Healthy Diet**

- **Excellent or Very Good Diet**   |   |       |       |       |             |
| Good Diet | 1.153 ** | 0.002 | 0.073 ** | 0.001 |
| Fair or Poor Diet | 2.394 *** | 0.000 | 0.185 *** | 0.000 |

Dietary Knowledge (heard of Dietary Guidelines for Americans, the Food Guide Pyramid, or the 5-a-Day Program)

| Strong (Heard of all 3 programs) | – | – | – | – |
| Medium (Heard of 1 or 2 programs) | -0.035 | 0.915 | 0.002 | 0.919 |
| Weak (Not heard of any program) | -1.375 *** | 0.001 | -0.083 *** | 0.014 |

Believe Some Are "Born to be Fat"

| Strongly Agree or Somewhat Agree | 0.185 | 0.707 | 0.001 | 0.979 |
| Neither Agree nor Disagree | -0.031 | 0.936 | -0.008 | 0.774 |
| Somewhat or Strongly Disagree | – | – | – | – |

Consumption of Non-Labeled Foods

<table>
<thead>
<tr>
<th>Number of Times per Week Eat Meals Not Prepared at Home</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never or Less Than 1</td>
</tr>
<tr>
<td>1-2</td>
</tr>
<tr>
<td>3-5</td>
</tr>
<tr>
<td>6 or more</td>
</tr>
<tr>
<td>Constant</td>
</tr>
</tbody>
</table>

N=3,251
R² Model 1 = 0.1728
R² Model 2 = 0.1491
Source: Author's analysis of data from the 2005-2006 National Health and Nutrition Examination Survey.

* Statistically significant at the 10% level
** Statistically significant at the 5% level
*** Statistically significant at the 1% level
**DISCUSSION**

The regression models examined in this study consistently show that, controlling for other factors, individuals who use nutritional labels to some degree have a higher BMI and greater likelihood of obesity than those who do not use or rarely use labels. Just as the Drichoutis and colleagues (2009) paper found that nutritional label use did not have an effect on BMI, the results of this study also call into question the common assumptions made that nutritional labels are a tool to help individuals maintain a healthy or a lower body weight. This study provides no evidence that label use helps people maintain a healthy BMI or achieve a non-obese weight.

There are several explanations for these results that must be considered. Heavier people may be more likely to make use of nutritional labels in attempt to lower their body weight. Those who “sometimes” use labels are more likely to be obese than those who “always” use labels, suggesting that there are benefits associated with more frequent label use. If repeated label use reduces one’s chances of being obese, this remains consistent with the Variyam and Cawley (2006) study, which found that label users tend to gain less BMI than nonusers.

Because the NHANES survey only provides cross-sectional data, it is not possible to determine how long an individual has been using labels and what affect this has had on their BMI over time. The data provided are merely a snapshot in time. Thus, it is possible that with repeated use of nutritional labels, heavier individuals may be able to decrease their BMI. Nevertheless, the NHANES survey does ask individuals if they “always use” or “sometimes use” labels, so affirmative replies indicate that these individuals have used labels for at least some period of time.
Additionally, it is possible that there is some measurement error in the data and individuals who claim to “always use” or “sometimes use” nutritional labels may have overstated their actual usage. It is also possible that individuals may read nutritional labels without understanding how to read and interpret them. For example, one may examine the fat and calorie content while ignoring the serving size information. Additionally, it may be the case that some individuals read and understand the nutritional labels, but simply chose to eat unhealthy foods anyway.

One important limitation to this study was lack of available data. It was not possible to control for all aspects of food consumed away from home, such as amount of money spent on food at stores other than grocery stores, money spent dining out, number of meals purchased at fast food restaurants, and frequency of eating “ready to eat” foods. Additionally, there were restricted measures on amount exercise. As demonstrated using the limited data available in this study, food consumed away from home and exercise both play an important role in determining an individuals body mass and deserve further examination. Individuals may consistently use nutritional labels and make healthy decisions about packaged foods, but failure to exercise regularly or consider the contents of unlabeled foods could significantly affect their weight status.

Based on the results of this study, policy makers cannot conclusively say that nutritional labels help individuals maintain a lower body weight or are an effective tool in the fight against obesity. Nutritional labels influence immediate consumer decisions, increase transparency and empower individuals to see exactly what they are eating. However, policy makers should not assume that these labels beneficially impact an individual’s overall BMI. Hundreds of millions
of dollars and man-hours are at stake to adjust products and policies to comply with the
PPACA’s requirements for more nutritional labels. With so many new mandates on food
producers, vendors, restaurants, and other small businesses to provide nutritional labels in an
effort to curb America’s obesity problem, it is worthwhile to take a closer look at the benefits of
these mandates: weight regulation may not be one of them.


**REFERENCES**


