Nutrition Labels and Obesity

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September 2008

Abstract

The Nutrition Labeling and Education Act (NLEA) imposed significant changes in the information about calories and nutrients that manufacturers of packaged foods must provide to consumers. This paper tests whether the release of this information impacted body weight and obesity among American adults. We estimate the effect of the new label using a difference-in-differences method. We compare the change before and after the implementation of NLEA in body weight among those who use labels when food shopping to that among those who do not use labels. In National Health Interview Survey data we find, among non-Hispanic white women, that the implementation of the new labels was associated with a decrease in body weight and the probability of obesity. Using NLEA regulatory impact analysis benchmarks, we estimate that the total monetary benefit of this decrease in body weight was \$63 to \$166 billion over a 20-year period, far in excess of the costs of the NLEA.

JEL Code: I18 (Health – Government Policy, Regulation, Public Health)
Keywords: obesity, labels, information

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Nutrition Labels and Obesity

The Nutrition Labeling and Education Act (NLEA) of 1990 represented the first comprehensive overhaul of the food labeling laws in the United States in over half a century.[1] Prior to the NLEA, food labeling was voluntary and labels were required only for products containing added nutrients or that made nutrition claims. This voluntary labeling regime was seriously outdated with no nutrition information appearing on at least 40 percent of packaged foods and the available information "incomplete and misfocused," according to a National Academy of Sciences study (Porter and Earl, 1990). The new NLEA-authorized regulations promulgated by the Food and Drug Administration (FDA) made it mandatory, starting in May 1994, for all packaged foods to display standardized nutrition information in a Nutrition Facts panel. The panel lists the amount of specified macronutrients, vitamins, and minerals contained per serving of the food. The regulations also require manufacturers to use specified serving sizes within product categories, declare nutrients as a percent of the recommended Daily Value, and use approved health and nutrient content claims (Food and Drug Administration, 1999).

Although not covered by the NLEA, the U.S. Department of Agriculture's Food Safety and Inspection Service (FSIS) has implemented a nearly identical set of nutrition labeling rules for meat, poultry and egg products which it regulates. Under FSIS's rules, all multi-ingredient and processed meat and poultry products must carry the Nutrition Facts panel. Labeling continues to be voluntary for raw fruits, vegetables, fish, and raw meat and poultry products. However, stores are encouraged to provide nutrition information in a variety of formats and display of information at the point of purchase is mandatory if the products are accompanied by nutrition or health claims. The NLEA thus triggered landmark changes in how the U.S. food system provides and markets nutrition information to the consumers.

The NLEA was motivated by a growing body of scientific evidence linking diet and chronic diseases such as cardiovascular disease, diabetes and some types of cancer. Two back-to-back reports documenting such evidence—the 1988 *Surgeon General's Report on Nutrition and Health*, and the 1989 National Research Council's *Diet and Health: Implications for Reducing Chronic Disease Risk*—provided impetus to the legislation. By improving access to nutrition information that is credible and comparable across products, the new labeling regulations were expected to help consumers choose a healthful, more nutritious diet (Kurtzweil, 1993, 1994). Other NLEA goals were to protect consumers from inaccurate or misleading health and nutrition claims on packages and to encourage manufactures to improve the nutritional quality of their food products.

The nutrition labeling changes instituted by the NLEA have scored important successes including reducing misleading claims by manufactures (Mayer et al, 1998), helping consumers acquire, comprehend, and use more nutrition information (Moorman, 1996; Balasubramanian and Cole, 2002;), and influencing consumer choice in specific product categories (Mathios, 2000). But have the label reforms succeeded in improving nutritional and health outcomes among Americans? In this paper, we attempt to provide an answer to this question on which, to date, there has been little research.

Evaluating the health impact of the NLEA is of considerable public policy interest for several reasons. First, as with all major federal regulatory efforts, the NLEA regulations were justified by benefit-cost analysis that showed benefits from the proposed label changes exceeding the costs of implementing the changes by several orders of magnitude. Specifically, FDA's regulatory impact analysis accompanying the final NLEA rulemaking rested on the claim that dietary changes triggered by the release of new information would result in reduced risk of disease such as coronary heart disease and cancer. FDA estimated the monetary value of these health benefits to be between \$4.4 to \$26.5 billion (1991 dollars) gained over 20 years. In comparison, the total cost of NLEA implementation, including administrative and compliance costs, was projected to be between \$1.4 billion and \$2.3 billion (Food and Drug Administration, 1993). What is not known is whether the projected benefits were realized once the regulations took effect. Reviewing the role of benefit-cost analysis in federal regulatory process, Graham (2007) stresses the importance of validation research to evaluate the accuracy of ex ante benefit and cost projections. Katzen (2006) argues for more systematic research of ex post costs and benefits of major regulations from federal agencies.

Second, providing information through mandatory information disclosures and public education efforts is an important mechanism used by the federal government to improve market functioning and increase consumer welfare. For example, in the diet-health arena, in addition to nutrition labeling, the federal government offers nutrition guidance through the release of the *Dietary Guidelines for Americans* and the accompanying *MyPyramid* food guidance system. In recent years, there have been increasing number of initiatives at the local level to enforce mandatory calorie labeling by fast food and chain restaurants. Whether through regulatory efforts or through public education, in providing information, the government is in effect lowering the information search costs faced by the consumers. It is important from theoretical and policy perspectives to assess whether these efforts have the expected effects on targeted outcomes such as dietary intakes and health.

Third, with the growing worldwide focus on diet and health, more countries are considering mandatory nutrition labeling regulations to achieve the public health goals of reducing obesity and preventing chronic disease (Hawkes, 2004). The World Health Organization's *Global strategy on diet, physical activity and health* suggests nutrition labeling as a way to meet the consumers' need for accurate, standardized and comprehensible information in order to make healthy food choices. As one of the first countries to introduce mandatory nutrition labeling for food products, the impact of nutrition labeling on health outcomes in the United States could provide valuable insights for implementing similar efforts in the rest of the world.

We evaluate the effect of the NLEA on health outcomes by examining whether the release of new information following NLEA's implementation impacted the body weight and obesity among American adults. Our focus on obesity addresses one of the chief concerns raised about NLEA in the recent debate about its effectiveness. The *Calorie Counts* report prepared by the FDA's Obesity Working Group in 2004 notes that "Despite reports of a positive correlation between label use and certain positive dietary characteristics, the trend toward obesity has accelerated over the past decade." Although obesity among Americans began to rise noticeably in the 1980s, it has continued to increase after NLEA regulations took effect in 1994 (Flegal et al., 2002). Aggregate adult medical expenditure attributable to obesity in 1998 has been estimated to range between $26.8 and $47.5 billion (Finkelstein, Fiebelkorn, and Wang, 2003).

In the next section, we review the existing literature on the effect of the NLEA and nutrition labeling on different consumer outcomes. Section 3 describes our empirical strategy for estimating the effect of the new label on body weight and the data and specific measures that we use to implement this strategy. Section 4 reports our main findings and results of sensitivity analysis to check the robustness of the estimates. In section 5, we calculate the dollar value of the BMI reductions due to the NLEA and conclude with a discussion of the implications of our finding for mandatory nutrition labeling policy in the U.S. and other countries.

Previous Research

Although NLEA has been in effect for nearly a decade and half, relatively few studies have explored its effect on dietary intakes and, to the best of our knowledge, none has studied its effect on obesity.[2] A few studies in the nutrition literature have examined correlations or regression-adjusted associations between label use and dietary intakes and diet quality, and reported beneficial effects associated with label use (Kreuter et al., 1997; Neuhouser, Kristal, and Patterson, 1999; Perez-Escamilla and Haldeman, 2002). A study that specified label use as an endogenous switching variable found significant beneficial effects for label use on the intakes of fats, cholesterol, sodium, and fiber (Kim, Nayga, and Capps, 2000). However, the label use equation was identified by excluding a potentially endogenous variable—whether an individual considers nutrition an important factor when shopping for food—from the intake equations. Kristal et al. (2001) used data collected from two rounds of a Washington State consumer sample in 1995-96 and 1997-98 to predict the impact of label use on intake of fat and fruits and vegetables and found that use of food labels was associated with reduced fat intake. The study did not control for unobserved effects that may have influenced both label use and intakes.

Moorman (1996) studied the effect of the NLEA on consumer comprehension and processing of label information using a longitudinal quasi-experimental design. The study gathered label use data from samples of consumers in October 1993 (N=554) and October 1994 (N=558)—eight months before and five months after the May 1994 implementation of the NLEA. Findings indicated that consumers acquired and comprehended more nutrition information following the introduction of the new labels. Relatively more information was acquired about nutritionally unhealthy products compared with healthy products, suggesting that labels may have a public health benefit. These findings are supported by another study with a similar pre- and post-NLEA design (Balasubramanian and Cole, 2002). NLEA changed consumer attention to negative nutritional attributes (such as fat and sodium, of which less is better) and more motivated consumers registered greater label search intensity in the post-NLEA period compared with the pre-NLEA period. Overall though, despite the spirited debate about the NLEA's effectiveness, research on the relationship between label use and dietary and health outcomes remains limited (Institute of Medicine, 2003; Pappalardo, 2001; Philipson, 2005).

Empirical Strategy and Data

Estimating the label effect

The cornerstone of the new food labeling framework instituted by the NLEA is the Nutrition Facts panel, which declares the nutrient content of the food in a standardized format. The panel information also serves as the basis for nutrition claims about the product. Thus, much of the benefit from the NLEA was expected to occur when consumers read the new labels and use the information in their food selection (Kurtzweil, 1994; Zarkin et. al., 1993). As noted earlier, nutrition labels existed before the NLEA under the voluntary labeling rules established by the FDA in 1975, but they were not on all packaged foods and were not standardized. We exploit this fact and estimate the effect of the new label on body weight by comparing the change in body weight of individuals who used labels in their food selection in periods before and after the NLEA's implementation with the change in the body weight over the same period of those who did not use the labels.

Suppose $\overline{WGT}$ denotes the mean of the body weight outcome variable, *u* and *n* indicate label user/nonuser status, and *a* and *b* indicate periods after and before NLEA. Using a difference-in-differences (DD) strategy, the label effect δ_l can be estimated from the equation

(1) $$\delta_l = (\overline{WGT}_u^a - \overline{WGT}_u^b) - (\overline{WGT}_n^a - \overline{WGT}_n^b) .$$

The label effect estimated from equation (1) would be unbiased if we have data from a randomized experiment in which subjects were randomly assigned to either the label user (*u*) or the label nonuser (*n*) groups. Since our data is nonexperimental, selection bias is a potential problem. Bias in our estimates of the impact of the NLEA on weight could result from two types of heterogeneity between the treatment group (those who read labels) and the control group (those who do not read labels): time-invariant heterogeneity, and time-varying heterogeneity.

Addressing Biases

Our DD model (1) eliminates all time-invariant heterogeneity in weight (from, e.g., diet, exercise, or other behaviors) between the treatment and control groups. This is because our DD estimator is based on the change over time (not the level) of the difference between the treatment and control groups, so any time-invariant difference between the two groups drops out. However, the DD estimator (1) cannot eliminate the influence of time-varying heterogeneity. That is, label users may have had different changes in weight than label nonusers over the period we examine due to factors that had nothing to do with the NLEA. If these factors are not taken into account, change in weight due to them could be wrongly attributed to the NLEA. To the extent that such factors are observable, such time-varying heterogeneity can be taken into account in the following regression:

(2) $$WGT_i = \beta_0 + \beta_1 LABEL_i + \beta_2 NLEA_i + \delta_l LABEL_i * NLEA_i + \boldsymbol{\beta}_3 \mathbf{X}_i + \boldsymbol{\beta}_4 \mathbf{X}_i * NLEA_i + \varepsilon_i .$$

The dependent variable WGT_i represents the weight outcome of the ith individual. $LABEL_i$ is an indicator variable that equals 1 if the individual is a label user and 0 if the individual is a label nonuser. $NLEA_i$ is an indicator variable that equals 1 for the post-NLEA years and 0 for pre-NLEA years. The coefficient δ_l for the $LABEL_i * NLEA_i$ interaction variable is the DD estimate of the effect of the NLEA. The vector of characteristics $\mathbf{X}_i$ controls for differences in weight outcomes due to other influences, and the interaction terms $\mathbf{X}_i * NLEA_i$ control for variation in the impact of characteristics on the dependent variable across the pre/post-NLEA periods. As we explain in the data section, these observable correlates of weight include age, sex, race and ethnicity, marital status, education, income, family size, urbaniztion , and region of residence.

Although DD model (2) eliminates bias due to observed time-varying heterogeneity, this still leaves our estimates susceptible to bias from unobserved time-varying heterogeneity. We draw on the richness of our data and present four different sensitivity tests to rule out the possibility that our results are influenced by time-varying unobservables. The tests we present include use of proxies for unobservables, examining weight trends within the pre- and post-NLEA periods, comparing the effect of label information that changed with the effect of label information that did not change between the pre- and post-NLEA periods, and verifying a prediction from the health production model about the efficiency in the use of health information by education level.

Data Source

We implement this empirical strategy using data from the National Health Interview Survey (NHIS). The NHIS is a multipurpose survey of the U.S. civilian noninstitutionalized population fielded annually since 1958. A probability sample of households is interviewed weekly by trained Census interviewers to obtain information about the health and sociodemographic characteristics of the household members. Additionally, supplementary questionnaires are administered periodically to gather detailed information on specific health topics of interest. Approximately 36,000 to 47,000 households, including 92,000 to 125,000 persons are interviewed each year. NHIS is the principal source of health statistics in the U.S. (National Center for Health Statistics, 2000).

The NHIS uses a multistage probabilistic sampling design to represent the U.S. civilian noninstitutionalized population. Each person in the covered population has a known nonzero probability of selection. Sample weights provided in the NHIS data files reflect these probabilities of selection, along with adjustments for nonresponse and post-stratification. The empirical analyses in this study were undertaken taking into account the sample weights and the complex sample survey design.

Nutrition Label Use

Our primary covariate of interest is the label use behavior of consumers over a time period that spans the NLEA implementation. During the 1991, 1993, 1995, and 1998 rounds of the NHIS, supplementary modules administered to adult respondents aged 18 and older included an identically worded question on food label use: "When you buy a food item for the first time, how often would you say you read the NUTRITIONAL INFORMATION about calories, fat, and cholesterol sometimes listed on the label—would you say always, often, sometimes, rarely, or never?" As noted earlier, currently the nutritional information listing the amount of calories, fat, and other nutrients is found on the Nutrition Facts panel. Under the voluntary labeling regime that existed prior to the NLEA, up to 60% of packaged foods had some form of labeling listing such nutrients (Porter and Earl, 1990). The NHIS label use question is thus general enough to capture label use before and after the NLEA. For our analysis, we classified "Always/Often/Sometimes" responders into the label user group and "Rarely/Never" responders into the label nonuser group.[3]

Since the NLEA was enforced starting May 1994, we consider the 1991 and 1993 waves of NHIS to be pre-NLEA data, and the 1995 and 1998 waves to be post-NLEA. Compared with previous studies such as Moorman (1996), the four NHIS samples provide a broader span of time around NLEA's implementation to assess its impact. The 1993 and 1995 samples provide data immediately prior to and following the NLEA and the 1991 and 1998 samples provide data more separated from the event. Our main empirical estimates are derived from pooled data with an indicator for pre-NLEA and post-NLEA periods. Unlike previous studies, the large sample size provided by the NHIS enables us to conduct analysis by race/gender subgroups. This is particularly important since weight outcomes have a significant genetic component and cultural/gender factors exert a strong influence on weight-related behaviors (Cawley, 2004).

Table 1 reports the proportions of the population who report reading labels when buying food. Estimates for pre- and post-NLEA periods are presented, both for the overall adult population and broken down by race/gender groups. Overall label use is steady over the pre- and post NLEA periods at 67%. In the way of comparison, using a similar label use definition as ours, FDA's Health and Diet Survey registered 70% label use in 1994 and 69% in 1995 and 2002 (FDA, 2004). In short, the NLEA does not seem to have altered the percent of people who use labels.

Body Weight and Obesity

We used Body Mass Index or BMI (ratio of weight in kilograms to the square of height in meters) as our primary outcome measure for estimating the impact of the new label on body weight. BMI was calculated from self-reported height and weight. In 1998 NHIS, all respondents personally reported their height and weight. In the NHIS for 1991, 1993, and 1995, height and weight were provided mostly by respondents, but in some cases proxy reports were used. NHIS provides a flag for proxy-reported height and weight and we excluded all such cases from our analysis. Since the onset of the health effects of excess body weight are especially linked to when a person is obese, we used an indicator for obesity status, defined as BMI $\geq$30, as an additional outcome measure.

Table 2 reports the mean BMI and percentage obese estimated for different population groups. In general, both the mean BMI and the prevalence of obesity have increased from the pre-NLEA to the post-NLEA period. Obesity is highest at around 30% among Non-Hispanic black women. Although Non-Hispanic white women have the lowest obesity, they recorded a higher rate of increase both in the pooled and yearly pre- and post-NLEA data compared with black women.

Other Covariates

The goal of our empirical analysis is to estimate NLEA's impact by comparing the change in body weight of label users over the pre/post-NLEA period with the change in body weight of label nonusers over the same period. NHIS respondents are not randomized into the treatment group (label users) or control group (label nonusers); they self-select into these groups. Therefore, label users and nonusers are likely to have different characteristics, and it is important to control for these differences. Previous research suggests that income, education, age, gender, household size and urban residence have significant influence on label use behavior (Kim, Nayga, and Capps, 2000; Neuhouser, Kristal, and Patterson, 1999). Table 3 lists these, as well as several additional sociodemographic and health characteristics that are included as controls in our models. There are some notable differences between the pre- and post-NLEA samples, which confirm the need to control for the change in the effects of these variables in our empirical models. Distribution of family income has shifted lower in the post-NLEA period. The NHIS provides only a categorical income measure. The original measure has a significant number of missing values. NHIS data files include separate family income files which replace the missing values with imputed incomes. We used these income measures in our analysis. For 1998, family income was imputed using a multiple imputation procedure. We took this into account using SUDAAN's multiple imputation option.

In 1993 and 1995, the supplementary questionnaires containing the label use questions were administered to only half the sample of adults. In 1995, these adults were distributed evenly throughout the year. However, in 1993, the half sample consisted of adults interviewed in the second half of the year. This is reflected in the higher proportion individuals in the 3rd and 4th quarters in the pre-NLEA sample (table 3). Any seasonality introduced by this is taken into account by including quarter dummy variables in our models.

We used several additional covariates to account for possible differences and changes in health status and preventive health behaviors, which serve as proxies for individuals' risk and time preferences. These variables were indicators for self-assessed health status, smoking status, tetanus shot in the past 10 years, routine medical checkup within the past year, blood cholesterol tested within the past year, and seat belt use when riding in the front seat. We also used respondent use of ingredient information on food labels to test for the sensitivity of the effect of the use of Nutrition Facts panel information. We describe the use of these variables in sensitivity tests in a later section.

Results

Basic Results

Table 4 reports estimates of the terms in equation 1, with the DD estimates of the NLEA effect, $\hat{\delta}_l$, presented in the final column. These estimates in Table 4 reflect models that do not control for sociodemographic or health characteristics (we will later present estimates from models that do control for those characteristics). The upper panel presents results based on BMI and the bottom panel gives results based on percent obese. Estimates were obtained for the overall population and for four major non-Hispanic race/gender subgroups. In all cases, label users had greater body weight compared with label nonusers in the pre-NLEA period. For example, the 1991-93 obesity prevalence in the population overall was 17.07% among label users and 14.51% among label nonusers. With the exception of white women, this pattern held in the post-NLEA period as well. This is likely because, at any given time, heavier persons may be using labels in their attempt to lose weight. For this reason, differences in weight status between label users and nonusers at any given time cannot be used to draw inference on the efficacy of the labels. What we are interested is in the change in weight status of label users and nonusers and the difference between these changes. These estimates are reported, respectively, in columns 3, 6, and 7.

Column 3 estimates in table 4 show that in most cases, the body weight (as indicated by BMI) of label users increased significantly from the pre-NLEA period to the post-NLEA period. Thus, it clearly the effect of the new labels hasn't been forceful enough to reverse the trend of rising obesity. However, besides label information, many other economic and social factors influence body weight. Changes in these factors could mask any potential label effect. Since these factors affect label nonusers as well, an estimate of their effect on body weight is given by the difference in weight of label nonusers across the pre- and post-NLEA periods. These estimates reported in column 6 show that, with the exception of black men, body weights of label nonusers also increased significantly from the pre-NLEA to the post-NLEA period. Column 7 reports the DD label effect, that is, the change in weight of label users minus the change in weight of label nonusers. With non-label effects removed, the body weight of the overall population of label users actually fell in the post-NLEA period, as measured both by the mean BMI and by percent obese. However, breakdown of the label effect by race/gender groups reveals great disparity. The largest beneficial label effect on body weight is for non-Hispanic white women. With the introduction of the new labels, there was a net reduction of 0.52 kg/m^2 in their BMI and a 3.36 percentage-points reduction in obesity. Obesity declined among black women as well, by nearly 5 percentage points, although the decline in their BMI wasn't statistically significant. New labels had no effect on the body weight of white men. For black men, we get a seemingly anomalous result: introduction of new labels actually increased their body weight. However, before reading too much into these results, we have to account for the possibility that the results could be due to selection bias—stemming from observable and unobservable differences in characteristics between label users and nonusers. To account for observable differences, we adopt the regression framework in equation 2.

Regression Results

Table 5 presents label effects estimated from DD regressions with a basic set of sociodemographic variables included as covariates. The covariates were interacted with $NLEA_i$, the post-NLEA indicator, to account for the time-varying effects of observables. We estimated two regression models, one with BMI (in logarithms) and another with obesity status as the outcome variable. For obesity regressions, we report results from a linear probability model. Results from logistic regressions were similar. Both models were estimated for the overall population and by non-Hispanic race/gender groups. For brevity, only the estimated label effects—that is, the coefficient of the $LABEL_i * NLEA_i$ interaction, $\hat{\delta}_l$—are reported.

The results are fairly clear. Non-Hispanic white women benefited from the new food label introduced by the NLEA. Their BMI on average was 1.63 percent lower than it would have been without the new labels. The mean BMI for white women in the sample was 25.11 kg/m^2. Therefore, the reduction in BMI due to label use was -0.0163*25.11=-0.41 kg/m^2. The obesity regressions lead to the same conclusions as the BMI regressions: Non-Hispanic white women benefited from the introduction of the new labels. Obesity prevalence among white women was 2.67 percentage-points lower than it would have been without the new labels.

The label effect is insignificantly different from zero for the rest of the race/gender groups, except black men. For black men, an anomalous significant increase in weight is observed. However, this result fails to be reproduced in an expanded regression model that controls for self-reported health status and smoking in addition to the basic sociodemographic variables. Table 6 presents label effects estimated from the expanded model. This time, the label effect is significant only for white women. Label use is associated with a 1.5 percent decline in BMI or 0.38 kg/m^2. The obesity regression suggests that obesity prevalence was 2.6 percentage-points lower as a result of label use.

Admittedly, health status and smoking are endogenous. For example, some individuals may smoke because smoking acts as an appetite suppressant and thus help them to reduce their weight. Those reported to be in excellent health may be so because of lower body weight.

However, these variables are also likely to capture individuals' preference for health and attitudes toward body weight that may affect their current weight and change in weight over time. Therefore, controlling for their changing effects may account for the effects of time-varying unobservables with which they are correlated. The inclusion of these variable does not increase the estimated label effect, rather lowers it.

In all the regressions reported in Tables 5 and 6, the effects of the sociodemographic and health covariates are along the expected lines (estimates not reported here but are available from the authors). Based on the regression estimate for the overall population, *ceteris paribus*, smokers have significantly lower (four percent) BMI and obesity than non-smokers. Those reported to be in fair or poor health have higher BMI and obesity compared with those in excellent or very good health. All the included sociodemographic variables have significant associations with BMI. BMI is positively related to age and negatively to family income and individual's education level.

Further tests on time-varying unobserved effects

As we have noted, the estimated label effects reported in Tables 5 and 6 could be biased upward if label users' weight declined from pre- to post-NLEA period more than label nonusers' weight due to the differential influence of unobservables on the two groups. Below, we present results from four different approaches we used to address this potential bias.

Proxies for unobservables: Table 7 presents results from BMI and obesity regressions for white women using several proxies that attempt to control for the potential unobserved time-varying effects of time and risk preferences. The first row reports label effects from models that add two indicators of forward looking preventive behavior: Having had a tetanus shot during the past 10 years and having had routine medical checkup within the past year (does not include visits about specific problems). Any change in these behaviors from the pre- to the post-NLEA periods are controlled by interacting them with the NLEA indicator. Results for both BMI and obesity show significant label effects, mostly unchanged from models without these additional controls.

The estimates reported in the second row of Table 7 control for having had blood cholesterol level checked within the past year and wearing seat belt all or most of the time when driving or riding in the front of the car. Here, the label effect is significant on obesity. The effect on BMI is insignificant. This could be due to fact that the cholesterol and seat belt questions were not asked in 1995 and therefore data from that year were excluded.

Effects across different periods: If time-varying unobservables influenced the label users' weight differentially than label nonusers' weight, then it is likely that this effect should be detected among label users prior to the treatment (NLEA implementation) occurring. The availability of two years of pre-NLEA data (1991 and 1993) allows us to test for such an effect. The results appear in the first row of Table 8. BMI and obesity regressions which include basic sociodemographic controls and health and smoking indicators as covariates are presented. We cannot reject the null hypothesis of no label effect prior to NLEA implementation.

Time-varying unobservables could also bias the results if their effects set in after the NLEA implementation. We test this possibility by estimating label effects for the post-NLEA years from1995 to 1998. The results appearing in the last row of Table 8 for both BMI and obesity show that there was no significant post-NLEA trend in weight among the label users compared with label nonusers.

Finally in the middle rows in Table 8, we present label effects estimated over different combinations of pre- and post-NLEA years where any actual effects of new label information on body weight is expected to be detected. As can be seen, either BMI or obesity or both show significant label effects for all combinations except 1991/1995. Thus, in summary, a label effect is detected only when comparing periods before and after the NLEA and not in periods before NLEA or in periods after the NLEA. This implies that the estimated label effect is due to the new information released by the NLEA and not due to trends in unobservables.

Effect of information that did not change: In each of the four years of our data, a second label use question was also asked in the NHIS. This question asked about respondent's use of ingredient information on the nutrition label. The question had identical structure and response categories as the Nutrition Facts panel use question. The pertinent difference between ingredient information and Nutrition Facts panel information is that the former remained relatively unaffected from pre- to post-NLEA period while the Nutrition Facts panel was radically changed by the NLEA.[4] The simultaneous availability of use of these two types of information allow us to test whether the effect we ascribe to the release of information about nutrients is truly due to changes in unobserved heterogeneity in who reads labels. If unobserved heterogeneity is a major factor, it will likely affect both the use of Nutrition Facts information and the ingredient information. Thus, we would expect both the indicators to have relatively similar effects on change in body weight from pre- to the post-NLEA period. However, if the release of new information had an impact, then only the Nutrition Facts use indicator will have a significant effect. Table 9 provides results from models that include indicators for the use of ingredient information and the Nutrition Facts information. The first row presents coefficients for the Nutrition Facts information indicator and the second row presents coefficients for the ingredients information indicator. We find an impact of the NLEA for those who read nutrient information on labels but not those who read ingredient lists; this is consistent with consumers responding to the new nutrient information and is not consistent with trends in unobservables causing our results.

Effects across education groups: A large literature has shown that there is a strong correlation between education and health outcomes, including obesity (e.g., Cutler and Lleras-Muney, 2006). A mechanism by which education affects health is through its impact on allocative efficiency—the more educated acquire and use more information about health inputs compared with the less educated. Alternatively, the correlation between education and health could be due to unobserved factors such as time preference (Grossman, 2006). Regardless of the mechanism, the strong association between education and health has two implications for determining the effect of label use on body weight. First, changes in unobserved factors related to education across the pre- and post-NLEA periods can show up as a label effect even if new information did not have a direct impact on body weight. Second, if new information did have an impact, it is likely that the effect will be larger among the more educated since they acquire and use the new information more efficiently than the less educated label users. We test both of these implications by estimating label effects by three education levels. Although we control for changes in educational attainment in all our previous models, estimating label effect within education groups would allow us to minimize the role of time-varying unobservables correlated with education. Table 10 reports the results. We find that label use has a significant effect on body weight for white women with some college education or higher. The estimated effect on BMI is double that estimated across all education groups (Table 6). There is no significant label effect among high school graduates or drop-outs.

In summary, we do not find an effect for label information when we shouldn't (in the pre- and post-NLEA periods, and for label-related information that stayed relatively similar before and after the NLEA). At the same time, we do find significant label effect when we should (after controlling time-varying unobservables by using proxies and among white women with higher educational attainment). Collectively, these results are reassuring and suggest that the estimated label effect is due to the new information released by the NLEA and not due to trends in unobservables.

Monetary Impact of the NLEA

As noted in the introduction, prior to the implementation of the NLEA, the FDA had estimated the health benefits from the new labels to be between $4.4 and $26.5, realized over 20 years (Food and Drug Administration, 1993). This estimate can be put in perspective given our finding of a beneficial effect of the label for non-Hispanic white women. We translate our estimate of the average reduction in BMI of white women due to the new label into dollar terms using four sources of potential benefits from the BMI reduction: lower mortality risk, lower medical expenditures, reduced absenteeism, and increased productivity.[5] Estimates of the implied marginal benefit from these sources associated with a reduction in one unit of BMI are obtained from published sources. We then assess the per-person value of the benefit attributable to the new label using our estimate of the BMI reduction of 0.3 kg/m^2 due to the NLEA.[6] For each source, this estimate is then multiplied by the number of non-Hispanic white female label users to get the total benefit attributable to the new label from that source. The number of non-Hispanic white women label users is estimated by multiplying the census estimate of white women in 1994 (the year of NLEA implementation) by 0.76, the average fraction of white women label users in our data. Finally, the benefits from all four sources are summed to obtain the total benefits from the NLEA.

Table 11 reports our monetary benefit estimates. The estimate for the reduction in mortality risk associated with lower BMI is from Calle et. al. (1999). They report age-adjusted death rates for white females at different BMI ranges. Based on overweight prevalence estimates reported by Flegal et al. (1998) using the 1988-94 NHANES data, we assume that the median non-Hispanic white female BMI in 1994 to be in the 23.5-24.9 range. From Calle et al., the implied marginal reduction in death risk for a 1-unit decline in BMI for white women from this range to the next lower category is 0.0133 percentage points. Using FDA's (Zarkin et. al., 1993) estimate of the value of statistical life in 1988 dollars ($1.5 million), the 0.3-unit BMI decline resulting from the NLEA has a monetary benefit of $60 per white female label user.[7] Across all white female label users, this implies that the reduction in mortality associated with the NLEA is worth $4.5 billion per year.

The extent to which the benefits last depends on how long the BMI reduction associated with label use is sustained. We present benefits calculated under three scenarios: (1) BMI reduction lasts for four years, starting in 1994 following the implementation of the NLEA and lasting till 1998, the final year used in our study. Under this scenario, the BMIs of the label users return to the pre-NLEA trend at the end of 1998; (2) BMI reduction lasts for 10 years; and (3) BMI reduction lasts for 20 years, the time frame for benefit projection used by the FDA in its final regulatory impact analysis for the NLEA. The FDA reported the value of health benefits in 1991 dollars, using a 5-percent discount rate. In the last three columns of Table 11, we report value of benefits under the three scenarios in 1991 dollars discounted at 5-percent. The estimated value of benefits from mortality risk reduction associated with label use among non-Hispanic white women over 4, 10, and 20 years are, respectively, $18 billion, $ 40 billion, and $65 billion.

Similar calculations for benefits from a four-year decrease in BMI associated with the NLEA imply benefits of about $7 billion from reduced medical expenditure (based on estimates for females from Finkelstein, Fiebelkorn, and Wang, 2003), $ 2 billion from lower absenteeism (based on estimates for females Finkelstein, Fiebelkorn, and Wang, 2005), and $21 billion from increased productivity (based on estimates for white females from Cawley, 2004).[8] Including mortality, the total benefits from the NLEA gained over a 20-year period is $169 billion (in 1991 dollars). If mortality benefits are excluded, the value of benefits over 20-years is $104 billion. Monetary value from a reduction in morality risk is the most comparable to FDA's analysis, and for this, our 10-year estimate of $40 billion is higher than the upper limit of FDA-projected benefits ($26.5 billion). Our conservative 4-year benefit estimate of $18 billion easily exceeds FDA-projected cost of implementing the NLEA ($2.3 billion). Based our estimates, therefore, the costs of the NLEA are far exceeded by the benefits associated with the reduction in the body weight of non-Hispanic white women.

Discussion

The Nutrition Labeling and Education Act (NLEA), enacted in 1990 and enforced since 1994, represented the first comprehensive overhaul of U.S. food labeling laws in 50 years. By providing access to consistent, standardized, and credible nutrition information, the law was expected to help consumers choose more healthful foods and thereby promote better health outcomes. To date, there has been little evaluation of NLEA impact dietary and health outcomes among Americans. Federal regulations such as the NLEA are supported by cost-benefit analysis FDA estimated the value of health benefits from new labels to be between $4.4 and $26.5 billion, realized over 20 years. The total cost of NLEA implementation, including administrative and compliance costs, was projected to be between $1.4 billion and $2.3 billion.

Using a unique set of pre- and post-NLEA data on the label use habits of U.S. adults, this paper examined whether mandatory labeling introduced by the NLEA had an impact on their body weight. Based on the estimated label effect , we our findings indicate that the NLEA labels had a beneficial impact, but only for one demographic group—non-Hispanic white females. As a result of the new labels introduced by the NLEA, the BMI and probability of obesity among white female label users were significantly lower than they would have been in the absence of the new labels. The total monetary benefit due to lower mortality, reduced medical expenditures, declining absenteeism, and increased productivity associated with this reduction in body weight was estimated to range from $48 billion over a 4-year period to about $169 billion over a 20-year period (1991 dollars).

Our estimates have significant implications for nutrition labeling initiatives in the U.S. and at the international level. One important implication is that label benefits may be limited to certain demographic groups. Future research should investigate why most groups in the U.S. do not seem to benefit (at least in terms of body weight) from these regulations. A second implication is that our assessment of the benefits of the mandatory labeling initiative in the U.S. may offer guidance for similar initiatives being considered by other countries.

Our study has some limitations. First, it is based on non-experimental data. If our controls (which include time-varying effects of education, income, marital status, health, and preventive health behaviors) do not adequately capture how self-selection among label users may have changed over time, our estimates could be biased. However, examining the stability of our results against such bias using four different sensitivity tests suggests that any bias is likely to be small. Second, there may be additional benefits due to dietary changes associated with the increased supply of healthier foods from industry reformulation of foods following the NLEA. Such benefits are not taken into account in this study. Third, any improvements in consumer welfare due to substitutions among foods that may result from the release of new nutrition information following NLEA's implementation are also not considered in this study.

Footnotes

1. For a timeline of food labeling laws in the United States and events leading up to the NLEA, see Kurtzweil (1993).

2. There is a more extensive literature on the determinants of label use, on the effect of nutrition labels that predate the NLEA on dietary outcomes, and on NLEA's impact on the food manufacturing industry. See Porter and Earl (1990), Teisl and Levy (1997), and Variyam (2005) for examples.

3. In addition to the five categories of frequency of label use ("Always" to "Never"), respondents were given a sixth option of "Don't buy food." Those who don't buy food are neither in the treatment nor control group and so we excluded them from our models.

4. We say that ingredient information was "relatively unaffected" because while products were required to display ingredient information all along, some standardized foods were exempt from ingredient listing. This exemption was removed as a part of the NLEA. Thus, the scope of the new information release with regard to ingredients was much smaller (Segal, 1993).

5. FDA's benefits estimates were based on the number of life-years gained due to dietary changes triggered by the new label. Specifically, the benefits were assumed to result from lower intakes of total fat, saturated fat, and cholesterol and the associated reduction in the risk of coronary heart disease and cancer (Zarkin et al., 1993). Therefore, our result for benefits from the reduction in mortality risk is the one most comparable to FDA estimates.

6. The label effect is obtained as the product of estimated coefficient for white women from Table 6 times their mean BMI: -0.0151*25.11 = 0.379, which, to be on the conservative side, we round down to 0.3.

7. Since overweight and obesity likely increased between 1988 and 1994, the assumption of median BMI in the 23.5-24.9 range for non-Hispanic white women in 1994 is conservative. If median BMI in the 25.0-26.4 is assumed, the per-person value of the implied marginal reduction in mortality risk increases to $162.

8. For medical expenditure and absenteeism, the implied marginal benefits are derived from a shift from the obese to the overweight category. For productivity, Cawley (2004) provides an estimate of the rise in wages that would result from a 1-unit reduction in BMI for white females. We interpret the wage as the marginal revenue product of labor, and therefore as a measure of productivity.

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Table 1. Nutrition Label Use in pre- and post-NLEA periods, 1991-98 NHIS

Sample	1991-93	1995-98
	Percent	
Overall	67.0	67.1
Non-Hispanic White Men	57.8	58.8
Non-Hispanic Black Men	58.3	57.7
Non-Hispanic White Women	75.2	76.8
Non-Hispanic Black Women	70.4	68.5

Table 2. Body Mass Index and Obesity in pre- and post-NLEA periods, 1991-98 NHIS

Sample	Pre-NLEA 1991-93	Post-NLEA 1995-98
	BMI (kg/m^2)	
Overall	25.5	26.2
Non-Hispanic White Men	26.1	26.6
Non-Hispanic Black Men	26.5	27.3
Non-Hispanic White Women	24.8	25.4
Non-Hispanic Black Women	27.6	28.1
	Obesity (%)	
Overall	16.1	19.1
Non-Hispanic White Men	14.9	18.1
Non-Hispanic Black Men	18.1	22.9
Non-Hispanic White Women	14.8	17.6
Non-Hispanic Black Women	30.9	30.3

Table 3. Variables and Sample Means (in percent, except for family size)

Variable	1991-93	1995-98
Age 18-24	10.5	11.0
Age 25-34	22.6	21.0
Age 35-44	21.4	22.4
Age 45-64	26.5	28.5
Age 65+	19.0	17.1
Male	39.4	42.6
Female	60.6	57.4
Non-Hispanic White	77.0	75.5
Non-Hispanic Black	11.2	11.0
Non-Hispanic Other	3.9	4.1
Hispanic	8.0	9.5
Married	61.5	59.9
Widowed	9.3	7.8
Divorced/Separated	12.3	11.7
Never Married	17.0	20.6
Family income <$5,000	0.8	2.3
Family income $5,000 - $9,999	1.9	4.2
Family income $10,000 - $14,999	2.5	4.9
Family income $15,000 - $19,999	2.4	4.7
Family income $20,000 - $24,999	9.8	8.5
Family income $25,000 - $34,999	16.1	14.8
Family income $35,000 - $44,999	12.1	11.6
Family income > $49,999	54.5	48.9
Family size	2.6	2.7
	(0.01)[a]	(0.01)
Less than High School (<12 yrs)	20.0	17.7
High School (=12 yrs)	37.0	32.4
Some College (13-15 yrs)	22.1	26.4
College (16+ yrs)	20.8	23.5
MSA	78.1	79.2
Non-MSA	21.9	20.8
Northeast	20.5	19.4
Midwest	24.6	24.7

Table 3. Variables and sample means

Variable	1991-93	1995-98
South	32.8	34.0
West	22.1	19.9
Quarter 1	11.6	25.0
Quarter 2	12.3	24.6
Quarter 3	38.1	25.3
Quarter 4	37.9	25.0
Read nutrition label always/often/sometimes	67.0	67.1
Read nutrition label rarely/never	33.0	32.9
Smoker	25.6	24.1
Nonsmoker	74.4	75.9
Excellent/Very Good Health	61.0	63.2
Good Health	25.7	24.9
Fair/Poor Health	13.3	11.9
Tetanus shot within 10 years	52.4	57.1
No tetanus shot	47.6	42.9
Routine checkup within a year	54.2	57.5
Routine checkup more than a year or never	45.8	42.5
Cholesterol checkup within a year	64.1	69.6[b]
No cholesterol checkup	35.9	30.4[b]
Seat belt use all/most of the time	74.5	82.1[b]
Seat belt use some of the time or never	25.5	17.9[b]
Read ingredient information always/often/sometimes	67.4	62.4
Read ingredient information rarely/never	32.6	37.6
Sample size (N)	64,760	49,757

[a]Standard error of mean in parenthesis.
[b]Question was not asked in 1995.

Table 4. Mean BMI and Percent Obese by Label Use Status and the Estimated Difference-in-Differences Label Use Effect, 1991-93 / 1995-98

Population	Label User			Label Non-User			Difference-in-
	1995-98	1991-93	Difference	1995-98	1991-93	Difference	Differences
			BMI (kg/m^2)				
Overall	26.26	25.67	0.59***	26.03	25.22	0.81***	-0.22**
Non-Hispanic:							
White men	26.93	26.39	0.54***	26.28	25.73	0.55***	0.01
Black men	27.94	26.71	1.23***	26.61	26.17	0.43	0.79*
White women	25.44	24.92	0.52***	25.36	24.32	1.04***	-0.52***
Black women	28.53	28.13	0.40**	27.32	26.47	0.86**	-0.45
			Obesity (%)				
Overall	19.69	17.07	2.62***	18.40	14.51	3.89***	-1.27*
Non-Hispanic:							
White Men	19.57	15.89	3.68***	16.52	13.89	2.64***	1.04
Black Men	26.60	18.92	7.67***	18.92	18.18	0.74	6.93**
White Women	17.29	15.18	2.11***	18.75	13.28	5.47***	-3.36***
Black Women	34.02	34.16	-0.14	28.16	23.32	4.84**	-4.98*

***=p<0.01, **=p<0.05, and *=p<0.10.

Table 5. Estimated Label Use Effect from Difference-in-Differences Regressions

Population	Log BMI		Obesity (1/0)		
	$\hat{\delta}_l$	R^2	$\hat{\delta}_l$	R^2	N
Overall	-0.0046	0.09	-0.0036	0.03	88,284
	(1.397)		(0.520)		
Non-Hispanic:					
White Men	0.0009	0.07	0.0132	0.03	24,843
	(0.119)		(1.149)		
Black Men	0.0293**	0.06	0.0668*	0.05	3,783
	(2.036)		(1.907)		
White Women	-0.0163***	0.07	-0.0267**	0.03	39,293
	(2.765)		(2.335)		
Black Women	-0.0060	0.08	-0.0377	0.05	7,894
	(0.454)		(1.336)		

Absolute t-ratios are in parentheses; ***=p<0.01, **=p<0.05, and *=p<0.10. Only estimated coefficient δ_l for the $LABEL_i * NLEA_i$ interaction term in equation (2) reported. All regressions also include controls for age, marital status, income, education, family size, MSA, region, and interview quarter, and the interaction of these variables with $NLEA_i$.

Table 6. Estimated Label Use Effect from Difference-in-Differences Regressions with Controls for Health Status and Smoking

Population	Log BMI		Obesity (1/0)		
	$\hat{\delta}_l$	R^2	$\hat{\delta}_l$	R^2	N
Overall	-0.0038 (1.173)	0.11	-0.0020 (0.296)	0.05	87,657
Non-Hispanic:					
White Men	0.0024 (0.510)	0.09	0.0178 (1.547)	0.04	24,691
Black Men	0.0214 (1.509)	0.09	0.0516 (1.503)	0.06	3,749
White Women	-0.0151*** (2.614)	0.10	-0.0255** (2.250)	0.05	39,002
Black Women	-0.0057 (0.431)	0.10	-0.0344 (1.202)	0.07	7,818

Absolute t-ratios are in parentheses; ***=p<0.01, **=p<0.05, and *=p<0.10. Only estimated coefficient δ_l for the $LABEL_i * NLEA_i$ interaction term in equation (2) reported. Regressions also include controls for age, marital status, income, education, family size, MSA, region, and interview quarter, plus indicators for smoking and self-assessed health status, as well as the interaction of all variables with $NLEA_i$.

Table 7. Label Use Effects for Non-Hispanic White Women with Additional Controls

Additional Variables	Log BMI	Obesity (1/0)
Tetanus shot, routine checkup	-0.0161***	0.0253**
	(2.678)	(2.149)
Cholesterol checkup, seat belt use[a]	-0.0104	-0.0300**
	(1.624)	(2.424)

Absolute t-ratios are in parentheses; ***=p<0.01, **=p<0.05, and *=p<0.10. Only estimated coefficient $\hat{\delta}_l$ for the $LABEL_i * NLEA_i$ interaction term is reported. Both sets of regressions control for age, marital status, income, education, family size, MSA, region, interview quarter, smoking status, and self-assessed health status, and the interaction of these variables with $NLEA_i$. In addition, regressions in the first row also include dummy variables indicating whether the respondent had tetanus shot in past 10 years, whether the length of time since respondent's last routine checkup is less than one year, and their interactions with $NLEA_i$. Regressions in the second row include dummy variables indicating whether time since respondent's last blood cholesterol check is less than a year, whether the respondent the respondent wears seat belt in front seat all or most of the time, and their interactions with $NLEA_i$.

[a] Excludes 1995 data because questions about cholesterol checkup and seat belt use were not asked that year.

Table 8. Label Use Effects for Non-Hispanic White Women Estimated Across Various Time Periods

	Basic Controls		Health and Smoking Added	
Period	Log BMI	Obesity (1/0)	Log BMI	Obesity (1/0)
Pre-NLEA Years				
1991/1993	0.0099	0.0157	0.0077	0.0132
	(1.398)	(1.166)	(1.102)	(0.982)
Pre-/Post-NLEA Years				
1991/1995	-0.0143	-0.0092	-0.0150	-0.0105
	(1.541)	(0.495)	(1.643)	(0.576)
1993/1995	-0.0242**	-0.0248	-0.0227**	-0.0237
	(2.369)	(1.253)	(2.286)	(1.220)
1991/1998	-0.0082	-0.0252*	-0.0078	-0.0247*
	(1.222)	(1.935)	(1.165)	(1.875)
1993/1998	-0.0180**	-0.0409***	-0.0155**	-0.0379**
	(-2.279)	(2.748)	(2.000)	(2.564)
Pos-NLEA Years				
1995/1998	0.0062	-0.0161	0.0072	-0.0142
	(0.621)	(0.823)	(0.740)	(0.738)

Absolute t-ratios are in parentheses; ***=p<0.01, **=p<0.05, and *=p<0.10. Only estimated coefficient $\hat{\delta}_l$ for the $LABEL_i * NLEA_i$ interaction term is reported. Basic controls include age, marital status, income, education, family size, MSA, region, and interview quarter, and their interactions with $NLEA_i$. The second set of columns report results from regressions which include the basic controls plus controls for self-assessed health status and smoking and the $NLEA_i$ interactions.

Table 9. Effect of the Use of Ingredient Information for Non-Hispanic White Women

	Basic Controls		Health and Smoking Added	
	Log BMI	Obese (1/0)	Log BMI	Obese (1/0)
Nutrition Facts Panel	-0.0174**	-0.0290**	-0.0158**	-0.0265*
	(2.281)	(2.043)	(2.109)	(1.872)
Ingredient Information	0.0021	0.0043	0.0014	(0.0023)
	(0.306)	(0.345)	(0.211)	(0.187)

Absolute t-ratios are in parentheses; ***=p<0.01, **=p<0.05, and *=p<0.10. The first row reports the coefficient $\hat{\delta}_l$ for the $LABEL_i * NLEA_i$ interaction term, which gives the effect of the use of Nutrition Facts panel information. The second row reports the coefficient for the interaction of an indicator for the use of ingredient information with $NLEA_i$ in the same regression. Regressions with basic controls include age, marital status, income, education, family size, MSA, region, and interview quarter and their interactions with $NLEA_i$. The second set of columns show results from regressions which include the basic controls plus controls for self-assessed health status and smoking and their $NLEA_i$ interactions.

Table 10. Label Use Effect by Education Level for Non-Hispanic White Women

	Basic Controls		Health and Smoking Added	
Education group	Log BMI	Obese (1/0)	Log BMI	Obese (1/0)
Less than High School	-0.0110	-0.0181	-0.0082	-0.0165
	(0.797)	(0.066)	(0.602)	(0.611)
Completed High School	-0.0090	-0.0237	-0.0095	-0.0251
	(0.964)	(1.314)	(1.025)	(1.386)
Some College or Higher	-0.0336***	-0.0385**	-0.0321***	-0.0354**
	(3.672)	(2.402)	(3.611)	(2.241)

Absolute t-ratios are in parentheses; ***=p<0.01, **=p<0.05, and *=p<0.10. Only estimated coefficient $\hat{\delta}_l$ for the $LABEL_i * NLEA_i$ interaction term is reported. Each row presents results from regressions within the education group. Basic controls include age, marital status, income, family size, MSA, region, and interview quarter, and their interactions with $NLEA_i$. The second set of columns show results from regressions which include the basic controls plus controls for self-assessed health status and smoking and the $NLEA_i$ interactions.

Table 11. Monetary Benefits from the NLEA

Source	Per-Person Value per Year[a] ($)	Total Benefit per Year (Million 1988 $)	Cumulative Benefits[b] 4 Years (Million 1991 $)	10 Years	20 Years
Mortality	60	4,500	18,372	40,007	64,568
Medical Expenditures	35	1, 623	6,627	14,431	23,291
Absenteeism	13	589	2,405	5,236	8,451
Productivity	74	5,048	20,608	44,877	72,427
Total (Excluding Mortality)	-	7,260	29,640	64,545	104,170
Grand Total	-	11,760	48,012	104,552	168,737

[a]Derived from published sources. Mortality value is based on marginal reduction in death risk due to lower BMI from Calle et. al. (1999). The value of a statistical life is taken as $1.5 million (in 1988 $) as in Zarkin et al. (1993). Benefits from reduced medical expenditures and absenteeism due to lower BMI are from Finkelstein, Fiebelkorn, and Wang (2003, 2005). Benefits from higher productivity is from Cawley (2004).
[b]Discounted at 5 percent. The per-year benefits are presented in 1988 $ and the cumulative benefits in 1991 $ for comparison with FDA's estimates reported in Zarkin et al. (1993) and Food and Drug Administration (1993).