# The Use of Food Nutrition Facts Panel Information and Juice Consumption

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## Abstract

The Nutrition Labeling and Education Act of 1990 requires that the FDA develop standardized Nutrition Facts Panel (NFP) labels for most packaged food products sold in the United States. The National Health and Nutrition Examination Survey (NHANES) reported more people were using the NFP. Per capita consumption of juices in the United States has decreased steadily, from 8.88 gallons in 2000 to 7.21 gallons in 2010. The purpose of this study is to examine the relationship between the use of the NFP and the consumption of juices in the US using cross-section data provided by the NHANES. We used data from three waves of NHANES: 2005–2006, 2007-08, and 2009-10. Because not all respondents consumed juice during the survey periods, a Tobit model was used in the analysis. Results show that using the NFP label has a negative impact on juice consumption and that there is a negative time trend in juice consumption. These results indicate that the juice industry needs to find a way to combat the negative impact of the NFP label on juice consumption, and to find out what is causing the negative time trend in juice consumption.


## Introduction

Poor diet is a significant cause of obesity, heart disease, stroke, cancer, diabetes, osteoarthritis, and other health conditions that impose an economic burden on individuals and society overall (USDA/USDHHS 2011; USDHHS 2010). The prevalence of childhood and adult obesity in the United States more than doubled between the 1976–1980 and 2007–2008 periods (Flegal et al. 2010; Ogden et al. 2010). The high rates of obesity and diet-related health problems have prompted consumers to watch their diets. In 2011, 51% of all adults aged 18 and over reported watching their diet (Mintel Oxygen 2012). Medical costs associated with obesity were estimated as high as $147 billion, or 10% of all medical costs, in 2008 (Finkelstein et al. 2009; O'Grady and Capretta 2012; Tsai et al. 2011). Growing recognition of the obesity epidemic and the prevalence of diet-related chronic diseases have led to an array of efforts aimed at increasing physical activity and promoting nutritious eating, including changes in the formulation, packaging, labeling, and marketing of food products and beverages (IOM 2010).

While 100% fruit juice has no added sugar, it does contain natural sugar. That is one of the reasons why consumers who try to decrease their sugar intake are drinking less fruit juice. As shown in Table 1, per capita consumption of juices in the United States increased from 5.53 gallons in 1970 to 8.9 gallons in 2000, an increase of 61%, before decreasing steadily to 6.76 gallons in 2011. The decreases of per capita consumptions of orange juice, grapefruit juice, and pineapple juice greatly contributed to the decline in total juice consumption. Buffard (2013) pointed out sugar content as the major culprit for the decrease in per capita consumptions of orange and grapefruit juices. According to the 2012 Internet survey conducted by Mintel Oxygen, one in seven non-consumers of fruit juices and fruit drinks claimed the high caloric content of these products as the reason for their non-consumption of these products. Even though current scientific evidence does not support a relationship between being overweight and fruit juice consumption (O'Neil and Nicklas 2008; Pereira and Fulgoni 2010), there is evidence suggesting that drinking juice is beneficial to one's health (Nicklas et al. 2008, 2010). A recent study by Kim and House (2014) found that beverage consumption was positively correlated to consumer health perception about beverages. This result implies that the publicity about sugar-content warnings may lead to negative perceptions about fruit juice. The downward trend in consumption is a major concern for the citrus juice industry.

The Nutrition Labeling and Education Act of 1990 provides the Food and Drug Administration (FDA) with the authority to require that the nutritional content and health claims on food product nutrition fact panel (NFP) labels are consistent with FDA regulations. The purpose of the NFP label is to provide consumers point-of-purchase nutritional information about products to help them make healthy dietary choices. In addition, the federal government has developed national nutrition guidelines and tools to help consumers obtain useful information about nutrition and

healthy eating from a variety of channels and sources. Despite the text-type information, the percentage of consumers 16 years old and older who do not use or rarely use the NFP information decreased from 43.7% in 2005 to 27.2% in 2007, and decreased again to 22.5% in 2009 (CDC 2013a).

Past studies found that consumers who reported using NFP label information consumed less total food energy and dietary fats than those who reported not using the NFP label information. For example, Ollberding et al. (2011) found that NFP label users had less food-energy and fat intakes than non-users. Temple et al. (2011) studied the food-energy intake of adults consuming lunch in a laboratory setting; they found that the group provided with nutrition labeling information consumed less food energy from low-energy-density and high-energy-density food sources than did the group that received no nutrition labeling information. Other studies also found that NFP information leads consumers to healthier diets (Guthrie et al. 1995; Variyam 2008) and helps improve the overall quality of consumers' diets (Kimet al. 2000, 2001).

The relationship between NFP use and juice consumption has both health implications for consumers and economic implications for the fruit juice industry. The purpose of this study is to examine the relationship between the use of the NFP and the consumption of juices in the United States using cross-section data provided by the National Health and Nutrition Examination Survey (NHANES).

**Data**

Data from three waves of the NHANES were used: 2005–2006, 2007-08, and 2009-10. NHANES is a national survey designed to assess the health and nutritional status of adults and children in the United States (CDC 2013b). These surveys collected dietary intake data in two

24-hour recall periods on consumer demographics, self-perceptions of health and nutrition status, and health-related behaviors. We focused on female participants who were 20 years old or older and not pregnant or lactating, who reported trying to lose weight or resisted gaining weight in the past year, and who provided reliable dietary intake information. Among the 31,034 respondents in the survey, 15,095 met our inclusion criteria. Of these 15,095 respondents, only 5,077 (33.6%) had consumed juice in the last year (66.4% of the respondents did not consume any juice).

**Covariate Measures**

In analyzing the relationship between the usage of food NFP label information and juice consumption, we controlled for consumer demographics, lifestyle, and other factors that may be associated with juice consumption. These factors include income, gender, marital status, race/ethnicity, education (Darmon and Drewnowski 2008; Kim et al. 2000); breakfast consumption (Ruxton and Kirk 1997); dietary supplement consumption (Guenther et al. 2004; Lyle et al. 1998); participation in food assistance programs, such as the Supplemental Nutrition Assistance Program (SNAP; aka food stamp) or the Special Supplemental Nutrition Program for Women, Infants, and Children (aka WIC) (LeBlanc et al. 2006; Wilde et al. 1999); lifestyle behaviors such as alcohol consumption (Breslow et al. 2006; Schuit et al. 2002); and self-rated health status (Watters and Satia 2009; Kim et al. 2012). Table 2 shows the definitions and codes of these variables.

**Model and Estimation Procedure**

In this study, we assume that the juice consumed by an individual is a function of the above mentioned variables, including how often the individual uses the NFP information. Because not

all respondents reported juice consumption, a Tobit regression was used to estimate (equation 1) consumption. Formally, the relationship can be written as

$$y_i^* = \beta' x_i + \varepsilon_i,\ \varepsilon_i \sim N(0,\ \sigma^2)$$
$$y_i = \begin{cases} y_i^* \text{ if } y_i^* > 0 \\ 0 \text{ if } y_i^* \le 0 \end{cases} \quad (1)$$

where $y_i$ is the quantity of juices consumed by respondent *i;* $x_i$ is a vector of determinants of juice consumption as discussed above, including a variable associated with how often the respondent used nutrition label information; β is a vector of the parameters to be estimated; and $\varepsilon_i$ is the error term followed using a normal distribution with a zero mean and variance $\sigma^2$. We used STATA (version 12.1; StataCorp, College Station, TX, USA) to generate the descriptive statistics and to perform the regression analyses. Note that since only 35% of the respondents consumed any juice, the Tobit model was estimated using the two-year sample weight. Note that the probability of being uncensored (equation 2) and the impact of changes in the explanatory variable on uncensored juice consumption (equation 3) can be estimated using the following formulas, respectively (Maddala 1983)

$$\frac{\partial \Pr(y_i > 0)}{\partial x_j} = \phi(z)\beta_j \quad (2)$$

$$\frac{\partial E(y_i \mid y_i^* > 0)}{\partial x_j} = \beta_j \left[ 1 - z\frac{\phi(z)}{\Phi(z)} - \left(\frac{\phi(z)}{\Phi(z)}\right)^2 \right] \quad (3)$$

where $z = \frac{\beta' x}{\sigma}$, $\phi(z)$ and $\Phi(z)$ are the probability density function and cumulative density function of z, respectively.

**Results**

Sample statistics are reported in Table 2. As Table 2 illustrates, 13.8% of the respondents always used the NFP information when shopping. Of the four age groups, the reference age group (those younger than 34 years old) account for about 33% of the sample; and the other three age groups account for about 20% each. The average household size is 3.26 persons and the average annual household income level is $48,223. Female respondents account for about half of the sample and married respondents account for 47.4% of the sample. Of the respondents, 47.7% are non-Hispanic White, 21.2% are Black, and 27.1% are Hispanic. About 42.5% of the respondents have a college education. Of the respondents, 18.3% are SNAP participants and 9.4% are WIC participants. Most respondents ate breakfast on the two interview days, with 41.8% of the respondents trying to lose weight and 10% of the respondents having tried to resist weight gain during the past year. About 30% of the respondents rated their diet as excellent or very good, and 64.6% rated their diet as good or fair. The reported average juice consumption rate was about six ounces for all participants and close to 16 ounces for juice drinkers.

Regression results are presented in Table 3; the first two columns are the Tobit estimates, which are followed by the probability of being uncensored observations (equation 2), and the marginal impacts on the uncensored observation (equation 3) are listed in the last two columns. As illustrated in Table 3, all estimates are statistically different from zero except the coefficients for Other Race, the dummy for 2007-08, and Losewt. The marginal impact estimates are smaller than the Tobit estimates as expected. As also illustrated in Table 3, the use of the NFP had a negative impact on juice consumption. Results show that if a juice consumer always used the NFP information, his/her juice consumption probability would decrease by 3% and his/her actual

juice consumption would decrease by 15.7 grams, or 3.4% of the average juice consumption based on uncensored observations.

The trend of juice consumption by age, race, and gender is consistent with the findings by Storey et al. (2006). Comparing the age groups, respondents between 35 and 49 years old have the lowest juice consumption, while respondents aged 60 years or older have the highest juice consumption. Black and Hispanic respondents consume more juice than do White respondents. Females consume less juice than do males. Household size is positively related to juice consumption, while household income and being married are negatively related to juice consumption. College education, SNAP and WIC participation, eating breakfast on a regular basis, and taking food supplements are positively related to juice consumption. Kim et al. (2012) also found that 100% fruit juice consumption has a positive relationship with education and a negative relationship with household income. A respondent's BMI and alcoholic beverage consumption are negatively related to juice consumption, and a respondent's diet self-evaluation is positively related to juice consumption. In addition, the number of American adults eating breakfast has declined. According to data from the NHNES, 82% of American adults ate breakfast in 2002, down from 89% in 1971, which may help explain declining fruit juice consumption (IFICF 2008).

The dummies for the second and third waves of NHANES are negative, an indication of a negative trend in juice consumption. It should be noted, however, that the coefficient estimate for the second wave of NHANES is insignificant.

Respondents trying to lose weight consumed less juice than those who did not try to lose weight; however, the coefficient estimate was insignificant. Kim et al. (2012) investigated beverage

consumption habits based on concerns about sugar content and calories. They found that consumers who were concerned about calories drank less 100% fruit juice than did consumers who were concerned about sugar content. This helps explain why consumers concerned about weight control their calorie intake while consumers concerned about health control their nutrition intake.

Among the explanatory variables used in the analysis, race, gender, and eating breakfast, are the most important factors in determining the juice consumption level as measured by the probability of consuming juices and the marginal impact on juice consumption when the respondent had already consumed juices.

**Discussion**

One hundred percent juices contain no added sugars and current scientific evidence does not support a relationship between being overweight and juice consumption (O'Neil and Nicklas 2008; Pereira and Fulgoni 2011). Furthermore, scientific evidence strongly maintains the nutritional benefits of 100% juices. On the one hand, some studies show that drinking 100% fruit juices is associated with a more nutritious diet overall, including reduced intake of dietary fat, saturated fats, and added sugars (Nicklas et al. 2008, 2010). On the other hand, some studies dispute the nutritional value of juices because they maintain that the sugars in juices are not much different from added sugars (Hamilton 2009; Braun 2014).

The results show that the estimated impact of NFP on juice consumption is relatively small (i.e., 3.6% of average juice consumption). The NFP information is only one of the many sources that consumers use to obtain nutrition information for food purchases. Other nutrition information

sources such as magazine articles and other research results, also have important impact on juice consumption and should be included in research analyses.

Results show that in addition to the NFP label's negative impact on juice consumption, there is also a negative time trend in juice consumption. These results indicate that the juice industry has to find a way to combat the negative NFP label impact on juice consumption, and to find out what is causing the negative time trend in juice consumption.

Identified as the top two "food felons" (Oz and Roizen 2013), refined sugar and sugar syrups damage the human body because they disrupt metabolism and cause cardiovascular and joint inflammation. One of the proposed changes in the NFP labels by the FDA is to add information about added sugar on food product packages. This change may help consumers to differentiate the sucrose, fructose and added refined sugars in juice to reduce the misconception that all sugars are bad and to increase juice consumption.

In an era when consumers are increasingly looking for nutritional information to improve their diet, this study contributes to the literature by exploring the effects of NFP labels on juice consumption. This is an important yet neglected issue in the research. Overall, the results of this study should generate interesting and fruitful discussion about the impact of NFP labels on juice consumption.

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Table 1. Per capita juice consumption, 1970–2011

| Year | Orange | Grapefruit | Apple | Grape | Pineapple | Other[a] | Total |
|---|---|---|---|---|---|---|---|
| 1970 | 3.72 | 0.57 | 0.54 | 0.22 | 0.27 | 0.22 | 5.53 |
| 1975 | 4.66 | 0.69 | 0.58 | 0.23 | 0.21 | 0.33 | 6.70 |
| 1980 | 4.95 | 0.58 | 1.10 | 0.25 | 0.31 | 0.23 | 7.41 |
| 1985 | 4.81 | 0.61 | 1.55 | 0.23 | 0.34 | 0.23 | 7.76 |
| 1990 | 3.25 | 0.91 | 1.74 | 0.28 | 0.50 | 0.34 | 7.02 |
| 1995 | 4.73 | 0.59 | 1.59 | 0.45 | 0.38 | 0.34 | 8.09 |
| 2000 | 5.54 | 0.53 | 1.80 | 0.34 | 0.30 | 0.39 | 8.90 |
| 2001 | 5.15 | 0.54 | 1.79 | 0.33 | 0.31 | 0.42 | 8.54 |
| 2002 | 5.02 | 0.47 | 1.80 | 0.37 | 0.32 | 0.38 | 8.37 |
| 2003 | 4.90 | 0.40 | 1.95 | 0.40 | 0.34 | 0.47 | 8.46 |
| 2004 | 4.94 | 0.38 | 2.13 | 0.38 | 0.27 | 0.41 | 8.51 |
| 2005 | 4.76 | 0.23 | 1.87 | 0.51 | 0.26 | 0.45 | 8.08 |
| 2006 | 4.39 | 0.20 | 2.22 | 0.44 | 0.27 | 0.45 | 7.98 |
| 2007 | 4.13 | 0.29 | 2.28 | 0.56 | 0.22 | 0.44 | 7.92 |
| 2008 | 3.79 | 0.30 | 2.11 | 0.45 | 0.27 | 0.46 | 7.38 |
| 2009 | 3.92 | 0.26 | 2.09 | 0.38 | 0.27 | 0.47 | 7.40 |
| 2010 | 3.74 | 0.22 | 2.21 | 0.37 | 0.21 | 0.45 | 7.21 |
| 2011 | 3.59 | 0.25 | 1.75 | 0.42 | 0.23 | 0.53 | 6.76 |

[a]Other juices include lemon, lime, cranberry, and prune juices.
Source: USDA (2012) Available at http://www.ers.usda.gov/data-products/food-availability-(per-capita)-data-system.aspx.

Table 2. Sample statistics and variable definitions, NHANES, 2005-06 thru 2009-10 (N=15,095)

| Variable | Definition | Mean | S.D. |
|---|---|---|---|
| Nfp5 | Always use the NFP =1; otherwise = 0 | 0.138 | 0.345 |
| ≤34 years | ≤34 years (reference group) | 0.328 | 0.470 |
| 35–50 years | 35–50 years = 1; otherwise = 0 | 0.245 | 0.430 |
| 50–64 years | 50–64 years = 1, otherwise = 0 | 0.205 | 0.404 |
| 65+ years | 65+ years = 1; otherwise = 0 | 0.221 | 0.415 |
| Household Size | household size (persons) | 3.260 | 1.695 |
| Income | household income ($000) | 48.223 | 29.457 |
| Female | Female = 1; otherwise = 0 | 0.508 | 0.500 |
| Married | married =1; otherwise = 0 | 0.474 | 0.499 |
| white | Non-Hispanic white (reference group) | 0.477 | 0.499 |
| OTHER | other races = 1; otherwise = 0 | 0.040 | 0.196 |
| Black | Non-Hispanic black = 1; otherwise = 0 | 0.212 | 0.409 |
| Hispanic | Hispanic = 1; otherwise = 0 | 0.271 | 0.444 |
| College | Had college or more education = 1; otherwise = 0 | 0.425 | 0.494 |
| FSP | food stamp program participants = 1; otherwise = 0 | 0.183 | 0.387 |
| WIC | WIC participants = 1; otherwise = 0 | 0.094 | 0.292 |
| BRFT | Days ate breakfast in the two recall days (0–2) | 1.692 | 0.585 |
| DSDCOUNT | # of food supplements taken | 1.025 | 1.748 |
| BMI | body mass index | 28.619 | 6.783 |
| ALQ | # alcoholic drink/day | 1.551 | 2.518 |
| Hdiet1 | Self-rated diet quality is excellent or very good | 0.299 | 0.458 |
| Hdiet2 | Self-rated diet quality is good or fair =1; otherwise = 0 | 0.646 | 0.478 |
| T2 | NHANES 2007-08 = 1; otherwise = 0 | 0.333 | 0.471 |
| T3 | NHANES 2009-10 = 1; otherwise = 0 | 0.361 | 0.480 |
| Losewt | Tried to lose weight in the past year = 1; otherwise = 0 | 0.418 | 0.493 |
| Ngainwt | Tried not to gain weight in the past year = 1; otherwise = 0 | 0.096 | 0.294 |
| Juice | Juice consumption full sample (g) | 155.676 | 310.953 |
| Juice (> 0) | Juice consumption for juice drinkers only (subsample, g) | 462.828 | 381.205 |

Table 3. Tobit regression results[a]

| Juice Consumption | Tobit Estimates | | $\partial Pr(y_i > 0)/\partial x_j$ | | $\partial E(y_i \mid y^* > 0)/\partial x_j$ | |
|---|---|---|---|---|---|---|
| | Coef. | Std. Err. | dy/dx | Std. Err. | dy/dx | Std. Err. |
| Nfp5 | –59.32* | 26.10 | –0.030* | 0.013 | –15.67* | 6.89 |
| 35–50 years | –176.60* | 25.61 | –0.089* | 0.013 | –46.64* | 6.71 |
| 50–64 years | –89.86* | 28.99 | –0.045* | 0.015 | –23.73* | 7.65 |
| 65+ years | 37.13** | 28.03 | 0.019** | 0.014 | 9.81** | 7.39 |
| Household size | 9.75** | 6.76 | 0.005** | 0.003 | 2.58** | 1.78 |
| Income | –0.54** | 0.34 | 0.0003** | 0.0002 | –0.14** | 0.09 |
| Female | –112.02* | 18.54 | –0.056* | 0.009 | –29.59* | 4.87 |
| Married | –36.27* | 19.89 | –0.018* | 0.010 | –9.58* | 5.25 |
| Other Race | 14.39 | 41.80 | 0.007 | 0.021 | 3.80 | 11.04 |
| Black | 264.35* | 22.18 | 0.133* | 0.011 | 69.82* | 5.66 |
| Hispanic | 167.49* | 23.04 | 0.084* | 0.012 | 44.24* | 5.99 |
| College | 95.89* | 19.18 | 0.048* | 0.010 | 25.32* | 5.06 |
| FSP | 40.56* | 25.28 | 0.020* | 0.013 | 10.71* | 6.67 |
| WIC | 42.74** | 32.36 | 0.022** | 0.016 | 11.29** | 8.54 |
| BRFT | 182.68* | 18.04 | 0.092* | 0.009 | 48.25* | 4.71 |
| DSDCOUNT | 16.86* | 4.99 | 0.008* | 0.002 | 4.45* | 1.31 |
| BMI | –5.12* | 1.51 | –0.003* | 0.001 | –1.35* | 0.40 |
| ALQ | –11.51* | 4.38 | –0.006* | 0.002 | –3.04* | 1.16 |
| Hdiet1 | 147.96* | 45.46 | 0.075* | 0.023 | 39.08* | 11.99 |
| Hdiet2 | 71.61* | 42.95 | 0.036* | 0.022 | 18.91* | 11.34 |
| T2 | –25.94 | 22.38 | –0.013 | 0.011 | –6.85 | 5.91 |
| T3 | –34.58* | 21.67 | –0.017* | 0.011 | –9.13* | 5.72 |
| Losewt | –25.56 | 20.50 | –0.013 | 0.010 | –6.75 | 5.41 |
| Ngainwt | 50.97* | 30.45 | 0.026* | 0.015 | 13.46* | 8.03 |
| Constant | –553.03* | 72.28 | | | | |
| Sigma | 689.433* | 17.740 | | | | |

[a]Weighted Tobit estimates.

*Statistically different from zero at $\alpha = 0.05$ level.

**Statistically different from zero at $\alpha = 0.10$ level.