The Effect of Nutrition Labeling on Consumption in Dining Halls

Honors Thesis
Presented to the College of Agriculture and Life Sciences, Biology and Society
of Cornell University
in Partial Fulfillment of the Requirements for the
Research Honors Program

by
Jamie A. Rosenthal
May 2009

David Levitsky, Ph.D.

In the spring of 2008, the Cornell Dining Service placed nutrition labels on various prepackaged meals throughout campus. Food sales data were analyzed before and after the nutrition labels were put into effect. While a number of previous studies have shown that consumers claim to read nutrition labels when purchasing foods, most of these studies have relied on self-reported data. Previous studies have also shown that consumers may not be able to use the information on nutrition labels correctly. Therefore, this study sought to determine whether the introduction of nutrition labels helped the Cornell community to purchase healthier food items. Foods sold in dining locations throughout campus were categorized by their amount of calories, fat, sodium, percent calories from fat, and fiber. Food sales data were analyzed using SPSS statistical software (version 14.0) to test for how sales data changed from the spring of 2007 to the spring of 2008. The results indicated that there were significant effects of the nutrition labels on which foods were purchased between the two years. Specifically, there was a decrease in the percentage of foods sold with high calories, fat, percent calories from fat, and sodium. However, there was also a decrease in the percentage of sales due to high fiber foods. This study has public policy implications, as menu-labeling laws are becoming more popular across the nation.

Introduction

In the past few decades, Americans have become fatter and fatter. The rate of obesity in the United States has doubled since two decades ago, and now, more than sixty-five percent of Americans are overweight and over thirty percent are obese.[49] In addition, obesity now accounts for $117 billion in U.S. health care costs annually.[49] This increase in obesity is party due to Americans eating more meals in restaurants and fast-food establishments.[7] In fact, between 1970 and 1996, "the amount of food dollars spent on meals prepared outside the home rose from 26% to 38%".[7] In hopes of stemming the rise in obesity, policymakers are now turning their attention to increased disclosure of nutritional information in restaurants. This is also a response to polling data indicating that consumers want access to nutritional information for foods and beverages offered at restaurants.[42] However, just because consumers *want* nutrition labels does not mean that they can or will use them correctly to make healthier food choices.

Laws requiring nutrition labels have preceded studies on their effectiveness and the efficiency with which consumers can incorporate the information into healthy eating choices. After reviewing literature on consumer food choices and the efficacy of nutrition labels, the present study analyzes food sales data from Cornell University's dining services to determine whether nutrition labels have effectively changed consumer food purchases within the university.

Factors Affecting Nutrition Label Use

Many factors affect which foods consumers choose to buy and subsequently eat. In addition to taste, convenience, and price, factors such as age, income, education level, socioeconomic status, and belief in the diet-illness relationship are associated with consumers' use of nutrition labels.

Petrovici et al. (2006) found that Romanian subjects who were younger, had higher educations, better comprehension of nutrition concepts, and higher incomes were more likely to read food labels. In the study, researchers randomly interviewed 485 subjects in Bucharest on their food buying behaviors.[40] Subjects were asked a variety of questions related to the diet-illness relationship, barriers to buying healthy foods, nutrition knowledge, and perceived diet effectiveness.[40] However, it is important to note that the results of this study cannot be generalized to the American population, because all of the subjects lived in Romania.

In 1997, Boulanger et al. (2002) sent a nutrition knowledge and behavior survey to 500 Latinas living in inner-city Hartford, Connecticut. Only subjects living in neighborhoods where at least half of the residents identified themselves as Latino in the U.S. census were included in the study.[5] Respondents were able to take the survey in either English or Spanish; 67% chose to complete the survey in Spanish while 33% answered it in English.[5] The survey asked questions relating to the Food Guide Pyramid, nutrition labels, and knowledge of dietary fat, cholesterol, and other nutrient requirements.[5] Six expert community nutritionists and two community staff members reviewed the validity of the survey questions.[5]

The study found that nutrition knowledge was significantly associated with age, level of education, employment status, and food label use.[5] However, an important limitation of not only this study but other studies of nutrition label use is that the researchers simply asked respondents how often they looked at nutrition labels rather than measured whether the respondents *actually* read the labels. This distinction between what respondents *say* they do and what they *actually* do is an important one. Perhaps respondents with higher nutrition knowledge, for instance, believed in the importance of reading nutrition labels, and thus overestimated how often they actually read them. Another important limitation is, again, the inability to generalize the results to the overall population, as all the subjects were Latinas living in inner-city Connecticut. Additionally, most subjects had a lower-than-average education level, as most did not complete high school.[5]

Fitzgerald et al. (2008) also studied Latinas living in Hartford, Connecticut. One hundred subjects previously diagnosed with type 2 diabetes and 101 controls were recruited from advertisements on bulletin boards and in health clinics.[14] Bicultural interviewers examined the subjects, who were between the ages of 35 and 60, for approximately 1 hour.[14] The interviews were conducted in the language of each subject's choice, with 86.1% conducted in Spanish, 8% in English, and 6% in both languages.[14] During the interview, participants were given a 25-item questionnaire, which tested their comprehension of the Food Guide Pyramid, the recommended number of servings for various food groups, and the sources of fat, saturated fat, cholesterol, and carbohydrates.[14] Subjects were also asked how often they used food labels to selected healthier foods.[14]

The researchers found that among the diabetes subject group, those who had seen a registered dietician or a diabetes educator had a greater understanding of nutrition concepts (p=.020).[14] However, the researchers also found that there was no significant difference in nutrition knowledge independent of previous nutrition education between the diabetes and control groups.[14] The authors also found that although higher education level was associated with greater nutrition knowledge, it was not associated with food label use when controlling for that knowledge.[14]

Studies have also demonstrated that food label use is associated with age. Levy et al. (1998) gave nutrition questionnaires to food shoppers from eight geographically dispersed malls and found that subjects who were over 55 years of age performed poorer on a food label use task than those who were younger. Satia et al. (2005), discussed below in the Do Consumers Look at Nutrition Labels? section, found that nutrition label use was significantly higher among participants who were women, older, educated beyond high school, and obese. Lastly, Neuhouser et al. (1999), also later discussed in the section, Do Consumers Look at Nutrition Labels?, found that food label use was significantly higher among women, consumers younger than 35 years of age, and those with more than a high school education. The same study did not find that subjects with a history of diabetes, hypertension, or cancer were more likely to use nutrition labels than healthy subjects.[37]

In summary, many factors influence consumers' nutrition knowledge and decision-making behavior concerning nutrition labels. However, studies assessing these factors have returned conflicting results. For instance, while one study found that older subjects used more nutrition labels[46], another study found that younger consumers were

more likely to use the labels.[37] However, most studies reviewed did find that those with previous nutrition knowledge, higher educations, higher incomes, and weight or obesity problems were most likely to look at nutrition labels.[45,14,46,37]

Are Nutrition Label Formats Too Confusing?

Previous research has shown that consumers may not read nutrition labels if the labels are too confusing or difficult to interpret. Anderson et al. (2008) sorted subjects into six single-gender focus groups and asked them to think of tools that might be helpful in identifying correct portion sizes. Subjects indicated that it would be most helpful to have visually-attractive pictures that referred to servings in the context of daily nutrient intake.[3] Subjects additionally felt that fridge magnets or leaflets would be more helpful than food labels.[3] A major limitation of this study, however, is that participants were simply asked what tools they thought would be most helpful in choosing healthier food items; the researchers did not actually determine which tools would be most effective. Additionally, since the study was performed in urban areas throughout central Scotland, the study's results cannot be generalized to the American public.

Another study compared performance and preference for five nutrition label formats using 1,460 food shoppers over the age of 18.[10] This study measured consumers' ability to interpret food labels by having them identify nutrient differences between two food items.[10] The study found that subjects' performance with and preference for certain nutrition label formats did not necessarily agree. For instance, the label design that the researchers referred to as the "Control format," which had no nutrition profile

information, performed the best but was the liked the least.[10] Alternatively, the format which provided nutrition information in the form of descriptive adjectives was the most preferred but did not perform well.[10] Another consumer research study divided 40 participants into four consumer focus groups and asked subjects which label formats they found most helpful.[10] This study reported that subjects did not find adjectival descriptors useful but instead preferred a numeric listing format, which listed both the nutrients in a serving and the percentage of the Recommended Daily Allowance for each nutrient.[10]

Levy et al. (1996) assessed the readability and effectiveness of seven different nutrition label formats. This study used a shopping-mall intercept design and chose subjects who were over 18 years of age and who did at least half of their household's food shopping.[29] A total of 1216 subjects were enrolled in the study. In the first task, subjects were shown the nutrition labels of two foods and were then asked to identify all the nutrient differences between the foods.[29] The second task had subjects evaluate the healthfulness of a food item before and after seeing its food label.[29] The difference between the two ratings was used as an indicator of the impact of the food label.[29] Another task had subjects assess whether nutrition statements were correct or incorrect based on the nutrition label.[29] The fourth task measured the subjects' ability to perform dietary calculations using food labels.[29] Subjects were asked how many servings of a certain food they should have in order to get all the carbohydrates they would need in a day.[29] At the end of all the tasks, subjects were shown a poster with the four nutrition label formats that they had previously used and were asked which would be most and least helpful for selecting nutritious foods.[29]

The study found that while subjects preferred what the authors referred to as "the highlighting format," they performed worst using that format.[29] The authors concluded that the subjects' beliefs about which formats would be most helpful did not predict actual performance.[29] One of the study's strengths is that it actually evaluated the effectiveness of food labels as opposed to simply basing its conclusions on hypothetical scenarios. Additionally, a large sample size increased the validity and generalizability of the study. However, the researchers did not state whether the time-consuming nature of the study hampered their ability to obtain a large and representative sample size. Subjects might not have wanted to spend a lot of time participating in the study during the middle of their grocery shopping. Rather than having subjects fill out a quick survey, the study asked very detailed questions and had the subjects perform a variety of calculations. Nonetheless, the researchers still managed to obtain a large sample size, so perhaps the time-consuming nature of the study was not a concern for subjects.

Somerick et al. (1998) surveyed a panel of 18 graphic arts education experts, who were members of the International Graphic Arts Education Association. The survey asked the experts to analyze FDA nutrition label guidelines and assess any "graphic problems" associated with a variety of nutrition label formats. The researchers defined a "graphic problem" as any "typographical design that harms readability".[48] The response rate was 83%.[48] According to the results, even graphic design experts disagree on what label formats are most effective.[48] For example, some respondents suggested changing the font style to improve readability, while others suggested increasing the font size or adding more spacing between lines.[48] The experts did not agree on how best to resolve "graphic problems."[48] However, this study did not actually test the effectiveness of various label

formats but instead asked graphic designers their opinions on improving nutrition label formats. Perhaps the respondents made suggestions that would improve the labels' visual appeal but not actually their effectiveness.

These studies have provided conflicting evidence as to the most effective nutrition label formats. Furthermore, the studies found a discrepancy between what formats consumers said they wanted and what most effectively helped them to incorporate the nutrition information into their dietary choices.

Do Consumers Read Nutrition Labels?

A thorough review of whether consumers actually read labels must also be examined in order to determine whether food labels can help consumers to make healthy food choices. Mackison et al. (2008) completed a meta-analysis of food label studies and concluded that most consumers claim to use nutrition labels at least sometimes. In another study, Satia et al. (2005) surveyed 658 African Americans between the ages of 20 and 70 living in North Carolina and had them fill out an 11-page questionnaire to assess their nutrition label use. Five thousand potential participants, randomly selected from the Department of Motor Vehicle rosters, were sent the questionnaire by mail.[46] Of the subjects, 41% of respondents were men, 37% were college graduates, and 75% were overweight or obese.[46]

The study found that 78% of respondents claimed to read nutrition labels when purchasing packaged foods.[46] Furthermore, those respondents who claimed to use nutrition labels usually or often (46% of respondents) ate significantly more fruit and

vegetables and had lower fat intakes than those who never read labels.[46] The authors did point out, however, that although nutrition label use was significantly associated with more healthful eating behaviors, it explained little variance in the foods that subjects claimed to eat; instead, demographic, behavioral, and psychosocial factors explained most of the variance.[46]

However, this study had severe limitations. As stated earlier, the distinction between what respondents *say* they eat and what they *actually* eat is important. This study asked respondents what they *would* eat as opposed to actually studying what respondents *did* eat. Subjects likely overestimated how often they used nutrition labels, and those who claimed to use food labels likely overestimated the healthfulness of their diets.

Neuhouser et al. (1999) found that while nutrition label use among 1,450 randomly surveyed adults living in Washington State was significantly associated with lower fat intake, it only explained 6% of the variance in fat intake. Additionally, the authors noted that nutrition label use was not associated with fruit and vegetable consumption.[37] Of the respondents, 59.5% were female, 29.3% had a college education, almost 90% were white, and 55.3 % claimed to use nutrition labels usually or often.[37] Again, a major limitation of this study is that it suffers from the problems associated with self-reported data. Additionally, this data can only yield correlational results; it is impossible to determine whether consumers who were health conscience chose to read nutrition labels or whether nutrition labels made consumers more health conscious.

Marietta et al. (1999) surveyed 208 undergraduate students (141 women and 67 men) in a Midwestern university in order to examine the students' nutrition label use and

ability to use those labels. The authors found that students' nutrition knowledge was positively correlated with their use of food labels.[33] However, previous education in reading nutrition labels was associated with higher knowledge scores and nutrition label use.[33] In fact, 80% of those students who had been previously taught how to read and use nutrition labels were more likely to look at those labels than those without previous nutrition education.[33]

However, the use of self-reported data in this study makes it difficult to infer causational information and determine whether higher nutrition knowledge leads to nutrition label use or vice versa. Students with previous nutrition education may have understood the importance of using nutrition labels, and thus claimed to use those labels more often than those without the same education. Without actually assessing food purchasing behavior, it is difficult to determine whether this was actually the case. Of the subjects, 70.2% claimed to read nutrition labels at least sometimes when purchasing prepackaged foods for the first time, but only 43.8% used the label at least sometimes to determine whether and how foods fit into their daily diet.[33]

Krukowski et al. (2006) used data from two separate telephone surveys to question subjects about their nutrition label use. One survey questioned a community sample in Vermont while the other surveyed Vermont college students.[25] The community sample consisted of 649 subjects (53.3% female), and the college student survey was composed of 316 subjects (56.0% female).[25] Response rates were 39.8% and 60.34% for the community and college samples, respectively.[25] Nutritionists and consumer economists developed the survey questions.[25] Of the subjects, 52% of the college students

and 33% of the community sample reported that they did not usually read nutrition labels.[25]

When asked if they would likely use caloric information if provided in restaurants, 44% to 57% of the combined sample stated that they wouldn't.[25] Again, the data in this study is self-reported, which is a huge limitation of the study. However, even with the self-reported data, it is interesting to note that still one-half of subjects stated that if given caloric information, they would not use it. Again, this percentage is likely to be overestimated, since it is likely that some subjects believed that they would use nutrition labels when, in fact, they would not.

As previously discussed in the section Factors Affecting Nutrition Label Use, Fitzgerald et al. (2008) surveyed Latinas in Hartford, Connecticut with and without type 2 diabetes and found that 82.1% of the subjects claimed to be familiar with nutrition labels and that 79.1% of them expressed confidence in their ability to use those labels. However, it should be noted that perceived confidence in ability to use food labels does not necessarily equate with actual ability to do so.

In conclusion, most studies found that approximately half of subjects claimed to read nutrition labels often or usually. However, most of these studies have been based on self-reported data, which is alarming considering that there may be a large discrepancy between what consumers claim to do and what they would actually do.

Do Consumers Adequately Utilize Nutrition Label Information?

Even if consumers do look at nutrition labels, they may not be able to effectively incorporate that information into making healthy food choices. In order to determine the percent of calories from fat, for instance, consumers must perform simple math calculations based on the nutrition label. If consumers do not understand how to read a nutrition label or be able to perform these simple calculations, they may not be able to fully utilize the information contained in these labels.

Rigby et al. (2008), for instance, tested whether providing nutrition booklets and nutrition labeling information to consumers changed buying habits. In their literature review, Rigby et al. (2008) mentioned that in another study, although 63% of the subjects read nutrition labels, only 25% claimed to understand them. Therefore, simply asking consumers how often they look at labels is clearly not enough to determine whether they they can correctly use and implement the information correctly.[43] Rigby et al. (2008) randomly assigned 78 participants to an intervention group and provided them with an information booklet and credit card sized nutrition and labeling information. Alternatively, 25 participants were assigned to a control group, which received the same information but only after four weeks of normal shopping.[43] All subjects in both the intervention and control groups provided the researchers with grocery shopping receipts during the study period.[43]

The intervention group bought significantly more fruits and vegetables ($p<.001$), fewer foods high in saturated fat ($p<.001$), and less white cereals ($p<.050$) than the control group during the weeks before the control group had access to the information

booklet and nutrition labeling information.[43] However, a significant limitation of this study is the disproportionate sample sizes of the intervention and control groups; the authors did not explain why the interventional group had more than twice as many participants as the control group. Nonetheless, this study did show that nutrition labels and information may improve buying behaviors and lead to a significant improvement in the types of foods consumers purchased.

Levy et al. (1985) used a meta-analysis design to review 265 papers studying nutrition labeling. The authors concluded that although most consumers claimed to read and understand nutrition labels, the studies that objectively assessed this understanding found that consumers had difficulty performing simple arithmetic calculations to determine portion sizes and had difficulty using nutrition labels to compare the healthfulness of various foods.[30]

As previously discussed in the sections Factors Affecting Nutrition Label Use and Do Consumers Look at Nutrition Labels?, Fitzgerald et al. (2008) found that those subjects who claimed to use food labels were more likely to consume more fruits and vegetables and less likely to consume sweets, salty snacks, and regular soft drinks than those who did not. However, those subjects who claimed to use food labels did not have significantly different intakes of legumes, grains, or dairy than those subjects who did not use the labels.[14] Nonetheless, a major limitation, once again, was the self-reported survey approach. Perhaps certain subjects over-reported both their nutrition label use and their consumption of fruits and vegetables, while they under-reported their consumption of sweets and soft drinks.

Another study that suffered from the self-reported survey design was Burton et al. (2006), which sent a nutrition mail survey to subjects in a south-central state. The study received a response rate of 50%, and all subjects were between the ages of 23 and 85.[6] Additionally, 97% of respondents were high-school graduates and 63% were female.[6] Subjects were provided with a menu of four items: a hamburger with fries, a chef's salad, a chicken breast with a baked potato, and a turkey sandwich.[6] The survey asked respondents to rate nutrient expectations of the various foods, and then asked them to choose which food they would prefer to eat.[6] Subjects were then provided with one of three pieces of information: (a) the amount of calories, fat, saturated fat, trans fat, and sodium in each food, (b) only the amount of calories in each food, or (c) no nutrition information.[6] Some subjects were additionally provided with the daily value of various nutrients while other subjects were not.[6] Subjects were then asked to re-evaluate which foods they would like to purchase if given the opportunity.[6]

Subjects who were provided with either all of the nutrient information or only the calories showed a significant decrease in purchase intention for the hamburger ($p<.01$ and $p<.05$ respectively).[6] The hamburger had more calories and a worse nutrient composition than subjects originally speculated.[6] Conversely, after being provided with the either calorie information or calorie-plus-nutrient information, more subjects stated that they would purchase the turkey sandwich than had originally done so. The turkey sandwich was healthier, on average, than the subjects had originally expected.[6] In fact, the percentage of consumers who chose the turkey sandwich increased from 11% to 21% after being provided with nutrient and/or calorie information.[6] No change in purchase intention was seen for the chicken dinner, which was consistent with nutrient

expectations.[6] Daily value information, however, had no effect on which items the consumers chose.[6]

Burton et al. (2006) concluded that purchase intentions decreased for food items that were nutritionally worse than expected but increased for items that were healthier than expected. However, a significant limitation of this study was that the subjects did not actually purchase the foods. Factors such as price, convenience, or even taste were not taken into consideration. All this study showed was that when given the choice, consumers would choose healthier food items if they knew which foods were healthier without actually having to consume those items. While this study did suggest that consumers could interpret calorie and nutrition information to determine which foods were healthier, it did not demonstrate whether consumers actually used this information in natural settings to purchase the healthier food items.

Levy et al. (1996), previously discussed in the section Factors Affecting Nutrition Label Use, gave nutrition knowledge questionnaires to food shoppers from eight geographically dispersed malls and had subjects complete four tasks: subjects had to identify nutrient differences between two similar foods, rate the truthfulness of front panel claims based on nutrition label information, determine the required amount of a nutrient needed per day, and determine the servings of a specific food needed per day.[28]

In the study, the subjects performed worst on those tasks that required mathematical calculations.[28] For instance, while 78% of subjects could accurately compare two foods, only 20% could correctly calculate the contribution of a specific food to their daily diet.[28] Furthermore, the authors concluded that "subjects were not very good at using the food label to make mathematical calculations, evaluate false claims, or draw

dietary implications about a product."[28] Additionally, while subjects could use information from nutrition labels to compare products, they could not "draw appropriate dietary implications" from the information.[28] The authors suggested that consumers may have difficulty in moving between product level and diet level of analysis.[28]

Levy et al. (1985) conducted a study in concert with both Giant Food, Inc. and the Food and Drug Administration. Posters flagging certain food items as low or reduced in sodium, calories, fat, or cholesterol were placed beside the price information for approximately 400 foods in ninety Washington, D.C. stores.[30] Additionally, consumers were provided with a 25-page nutrition guide that defined the terms "low" and "reduced," listed flagged products, and offered dietary hints.[30] Lastly, the program was advertised through radio and television commercials, and 40% of the advertisements occurred within the first eight weeks of the program.[30]

For the study, ten of the Washington, D.C. stores were matched in terms of size and socioeconomic characteristics with ten stores from Baltimore, which were not provided with the posters, 25-page guide, or media advertisements.[30] Consumer purchases of flagged and non-flagged items were tracked through a computer-assisted checkout counter.[30] Approximately 1600 food items (and 23 food categories) were tracked in each store.[30] The program lasted for two years and weekly data was collapsed into 26-week intervals.[30] The results indicated that more of the flagged foods sold in the Washington, D.C. stores than in the Baltimore stores, indicating a positive program effect.[30]

The higher sales of the flagged foods, however, varied notably between various food categories, with some foods selling more than others.[30] Furthermore, it is difficult to

tell whether the program effect was due to the posters, the 25-page nutrition guide, or the radio and television advertisements. While the authors mostly attributed the results to the posters, it is unclear whether this was actually the case, especially since the authors stated that the television and radio advertisements were estimated to have reached 86% of Washington, D.C. women aged 25-54 years old.[30]

The results of this study, nonetheless, indicate that the combination of both nutrition education and food labels may prove more effective than either alone. The main difference between this study and the present one, however, is that the posters used in this study did not state nutrition facts but rather labeled foods as low or high in a certain nutrient. Consumers must work harder, and thus may be less inclined, to read and interpret a nutrition label rather than a poster which states that a food is high or low in a specific nutrient.

Teisl et al. (1997) also used a grocery store design to test the efficacy of nutrition shelf labeling. Stop & Shop Supermarkets placed brand-specific nutrition information, which stated whether the food was low or reduced in fat, cholesterol, sodium, or calories, on the shelf next to the price information of various foods.[50] Twenty-five supermarkets in Connecticut, Rhode Island, New Hampshire, and Massachusetts were selected to participate.[50] For the first year of the study, thirteen of the stores were provided with the shelf tags, information booklets and posters, and an explanation of the program.[50] For the next two years, the thirteen stores only contained the shelf tags.[50] Product sales of approximately 11,600 products were tracked during the study period.[50] Products were placed into either “healthy,” “unhealthy,” and “all other” food categories, and only the

"healthy" foods contained the shelf tags.[50] The twelve control stores did not contain any shelf tags.[50]

The labeling program significantly increased the percentage of "healthy" milk, refried beans, and peanut butter purchased.[50] While the percentage of purchases for "healthy" cream cheese also increased, it was not statistically significant.[50] However, more consumers started buying "healthy" milk relative to the "unhealthy" milk even without the labeling program in place.[50] Additionally, the percentage of "healthy" salad dressings and mayonnaise purchased during the study period actually decreased.[50] The authors concluded that the main effects of the program occurred quickly at the beginning of the study.[50] Furthermore, the results may have been a result of the promotional information booklets and posters provided at the beginning of the study and not solely a result of the shelf tags.[50]

Russo et al. (1986) also used a supermarket study to measure the effects of added sugar to breakfast cereals on buying behaviors. Two matched supermarkets were pre-tested for 24 weeks, tested for 8 weeks, and then post-tested for an additional 8 weeks.[45] Cereals were categorized by sugar level, which was defined by the number of teaspoons of added sugar per one ounce serving.[45] Supermarkets in the experimental group had posters listing the grams of added sugar in all breakfast cereals.[45] Posters listed the cereals both alphabetically and based on sugar level.[45] Additionally, take-home replicas of the posters with information about why and how to eat less sugar were provided to consumers.[45]

The results showed a .37 gram decrease in sugar per ounce of cereal purchased in the experimental stores ($p=.05$).[45] Furthermore, this decrease remained stable over the

duration of the study (p=.05), and the market share of the lowest-sugar cereals increased by 2.7 percent while that of the highest-sugar cereals decreased 2.3 percent.[45] Furthermore, once the posters were removed, the statistically significant effects immediately disappeared.[45] However, one main limitation of this study, and seen in other similar studies, is that the effects cannot solely be attributed to the posters and instead may be the result of the in-store promotion explaining the study and providing information on how to reduce sugar intake. Conversely, the present study did not have any in-cafeteria promotion and did not provide any additional materials that may have influenced consumer buying behaviors.

Rothman et al. (2006) surveyed 200 primary care patients using a 24-item food label questionnaire. Of the 234 referred patients, only 200 completed the study; five failed the vision test, 14 refused, and 15 started but did not finish the survey.[44] Sixty-eight percent of respondents had completed at least some college education.[44] All the questions referred to actual nutrition labels and subjects were provided with a pencil and paper to perform calculations.[44] Rothman et al. (2006) found that although 89% of subjects reported using nutrition labels, the subjects, on average, only answered 69% of the food-label questions correctly.

This study is important because it assessed subjects' ability to interpret and use nutrition labels. Additionally, because 68% of subjects had some college education, the subjects were similar in education level to those in the present study, who were primarily college students.[44] However, the authors did not explain the criteria used by primary care physicians to decide which subjects to refer to the study. Additionally, since the subjects were primary care patients, they might not have been representative of the general

population. Nevertheless, the study did support the notion that consumers may have trouble interpreting and using nutrition labels to perform simple calculations.

Aaron et al. (1995) studied college students eating lunch in a student cafeteria.[1] Sixty-five college students (40 males and 25 females) ate lunch in the same main cafeteria for two weeks. During the second week, they were provided with recipe details, portion sizes, and laminated labels with information on the energy and fat content of the food items.[1] The experimental subjects went to school at a British university, regularly ate their lunch at a main cafeteria on campus, and were recruited through public advertisements.[1] Alternatively, twenty-five control subjects from the same university (16 males and 9 females) were enrolled in the study only if they never ate at the main cafeteria.[1] The control subjects ate at an alternative cafeteria during the two-week study period.[1]

Unexpectedly, the results showed that the experimental subjects ate significantly *more* total energy, grams of fat, grams of carbohydrates, and fewer grams of protein than the control subjects when only the experimental subjects were presented with the nutrient information.[1] The authors attributed this increase in energy intake in the experimental group not to the nutrition labels but instead to the eating behavior of males and less restrained eaters.[1] For the control subjects, the only difference in eating behaviors between the two weeks was an increase in energy from carbohydrates during the second week.[1]

In response to a debriefing questionnaire, 73% of experimental subjects stated that the nutrition labels had no influence on their food choices.[1] Additionally, when subjects were asked if they would use nutrition labels if they were introduced in the future, 63.3%

felt they would only occasionally use them.[1] One major limitation of the study was that the control subjects were students who never ate in the main cafeteria, while the experimental subjects routinely did. Perhaps the control and experimental subjects, therefore, were somehow innately different.[1] Additionally, the authors did not explain why males or restrained eaters would eat more during the second week than the first. Even with the limitations, however, it is important to note that while 63% of the subjects claimed they would use nutrition labels if provided in the future, only 27% of the experimental subjects claimed to use them during the study period.[1]

Kral et al. (2002) also investigated the effect of nutrition information on energy intake. Forty normal-weight women were recruited through advertisements in the Pennsylvania State University campus newspaper.[23] Subjects were between the ages of 18 and 45, healthy, not athletes in training, not pregnant or lactating, non-smokers, free from food allergies, not dieting, regularly eating 3 meals/day, normal-weight (BMI = 20-25), and weight-stable for the previous 6 months.[23] All subjects were required to attend a practice session in the laboratory before beginning the study.[23] Both the control group and experimental group subjects were required to eat breakfast, lunch, and dinner in the laboratory for three days.[23] On a given day, the three main entrées all contained the same level of energy density.[23] The different entrées were matched for macronutrient composition and palatability.[23] However, the energy density of the foods were varied each day and were either 1.25, 1.50, or 1.75 kcal/g, depending on the amount of apple pie filling and granola for the Apple Bake Crisp and vegetables and pasta for the Pasta Salad and Italian Pasta Bake entrées.[23]

Subjects were instructed to eat as much as the entrée as they wanted but were required to eat the entire side dishes that were provided.[23] A registered dietician provided the experimental group subjects, with nutrition training prior to the start of the study.[23] The experimental group was also provided with a nutrition label, which was color-coded according to the level of energy density, for each entrée.[23] The label contained the level of energy density (low, medium, or high), the actual energy density (1.25, 1.50, or 1.75 kcal/g) and the weight and energy content of the entrée per serving.[23] Experimental subjects were also provided with a questionnaire after eating each meal, which asked them whether they had read the nutrition label, whether they knew the level of energy density of their meal, and whether the nutrition label influenced their food intake.[23]

Subjects in both the experimental and control groups ate less food when provided with the highest-energy meals compared to the medium or low energy-density meals ($p<.03$).[23] However, no difference in food intake was found between the experimental and control subjects when controlling for energy density.[23] In other words, the nutrition labels had no impact on food intake.[23] It is interesting to note that even with the nutrition training, the experimental group failed to eat a different amount of food than the control group.[23] The authors concluded that increased nutrition knowledge did not translate into behavior change.[23] However, the authors did not ask participants for their level of prior nutrition knowledge.[23] If all subjects had a high level of previous nutrition knowledge, then perhaps they did not need the nutrition labels to correctly assess the nutritional content of the foods provided.[23]

Researchers in the Rudd Center for Food Policy & Obesity at Yale University recently argued that nutrition studies have shown that consumers routinely consult food

labels, which leads to a decrease in the purchasing of less-healthful food items.[42] However, the studies reviewed in this paper provided conflicting evidence for whether consumers actually purchased more healthful items as a result of nutrition labels. Although many studies found that consumers claimed to read nutrition labels, many also found that the subjects did not adequately and appropriately utilize the information on the labels to make healthier food decisions.

Furthermore, Mackison et al. (2008), previously discussed in the section Do Consumers Look at Nutrition Labels?, completed a meta-analysis of nutrition label studies and concluded that "little information is available on the consumers' use and application of nutrition information on food labels". Mackison et al. (2008) came to the conclusion that further research is required in order to better understand how consumers apply nutrition label information to their food choices. Therefore, the present study aims to further examine whether consumers can adequately apply information from nutrition labels in order to help them choose healthy food options.

Hypothesis

The purpose of the present study is to examine whether the Cornell community uses the information on nutrition labels to help them buy healthier foods. The literature review has shown that many studies have found that a large percentage of consumers cannot perform simple calculations using nutrition labels. Furthermore, studies examining consumers' use of labels have come up with conflicting results. Therefore, the hypothesis is that there will be no change in foods purchased as a result of the nutrition

labels.

Methods

Nutrition labels were added to prepackaged food items in dining locations throughout campus starting in the spring of 2008 semester. Total food sales data from all dining locations at Cornell were collated electronically, were provided to us by the Cornell Dining Service for the spring of 2007 and the spring of 2008 semesters, and were used for the analysis. The data set originally included 8572 data points with each food item categorized according food item, the number of items sold, dining location, week, and year.

Foods that were not sold in all the dining locations for both the spring 2007 and spring 2008 semesters were excluded. Nine food items were thus excluded because they were not served in all the dining units (small Caesar salad, Mediterranean sampler, Mediterranean salad, small pita with hummus, herb mozzarella & tomato cup, three bean salad, macaroni salad, potato salad, and ham and Swiss sandwich without condiments).

Six food items were additionally excluded because of insufficient nutrition information (buffalo chicken wrap, Caesar chicken wrap, chicken mesclun ranch wrap, turkey club wrap, shrimp salad wrap, and tuna salad wrap). Finally, eleven food items were excluded because of insufficient information about when and/or in which dining locations the foods were sold (cole slaw, bologna sub, chicken mesclun wrap, large Caesar salad, large Caesar salad with chicken, large chef salad, large pita with hummus,

large spinach salad, large tossed salad, pasta salad, and roast beef nicoise sandwich). After these exclusions, the final data set consisted of 7632 data points.

The nutrient composition of each food item was used to categorize the foods into terciles based on calories, fat, sodium, percent calories from fat, and fiber for the spring semester (2008) when the labels were introduced and for the previous spring semester (2007) when the labels were not used. Each food was categorized into low, medium, or high for each nutrient. First, the range of each nutrient was determined and each food was categorized as 1, 2, or 3 based on how much of each nutrient it contained. Category 1 contained the foods with the lower 1/3 of a specific nutrient while category 3 consisted of the foods with the upper 1/3 of a specific nutrient.

For instance, the range of calories in the foods varied from 45-1100 calories. Foods with 0-396.7 calories were categorized as "1," while foods with 396.7-748.3 calories were categorized as "2," and foods with more than 748.3 calories were categorized as "3". Similarly, the range of fat varied from 0-64 grams. Categories 1, 2, and 3 were based on 0-21.3g, 21.3-42.7g, and >42.7g of fat, respectively. Sodium ranged from 5-2780mg. Categories 1, 2, and 3 were defined by 5-930mg, 930-1855mg, and >1855mg of sodium, respectively. The percent of calories from fat ranged from 0-82.5 percent with 0-27.5%, 27.5-55.0%, and >55% defining categories 1, 2, and 3, respectively. The dietary fiber in the foods varied from 0-16 grams. Foods with 0-5.3g were categorized as "1," while foods with 5.3-10.7g were categorized as "2," and foods with more than 10.7g calories were categorized as "3".

Total sales for spring 2007 and spring 2008 were plotted. For each nutrient, the percentage of foods sold for the high-nutrient (category 3) foods were plotted for each

semester as a function of week. Additionally, graphs with the number of medium calorie food items sold as function of week and year, the number of low calorie foods sold as a function of week and year, and the mean weekly percent of high, medium, and low calorie foods were plotted. Week 1 on all graphs corresponds to week 4 of each year, because that marked the beginning of academic classes for the spring semester. Additionally, week 9 on each graph corresponds to the week of spring break for each semester.

Statistical Methods

Weekly food purchase data was first incorporated into Excel, where various extraneous lines were removed from the data. The Excel data was then imported in SPSS statistical software (version 14.0) and combined. The data were then analyzed using the multivariate version of the General Linear Models (GLM) for statistical significance

Results

Figure 1 is a graph of total sales as a function of week and year. The graph illustrates that significantly more foods were sold every week during spring 2008 than spring 2007 ($p<.001$).

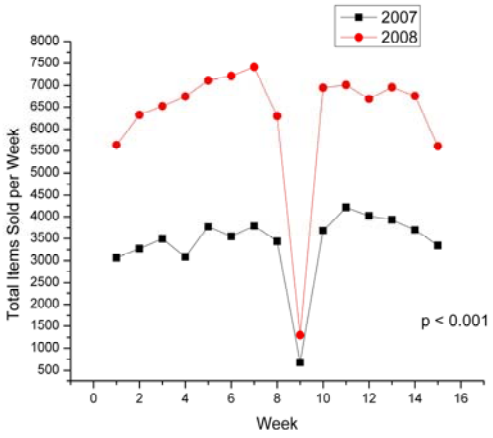

Figure 1: Total Sales As a Function of Week and Year

Figure 2 is a graph of the number of high calorie food items sold as function of week and year. While significantly more high calorie foods were sold during the spring of 2008 semester than the spring of 2007 semester ($p<.01$), this was expected, since total sales increased during the second year.

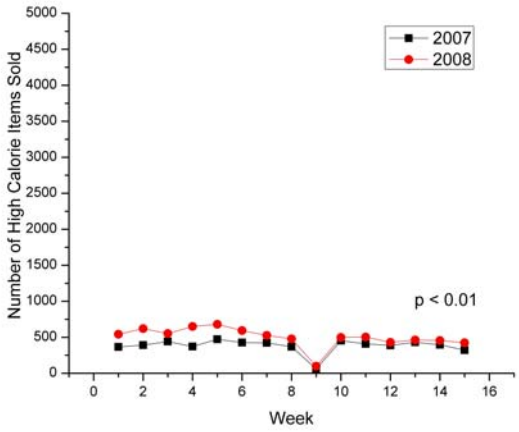

Figure 2: Number of High Calorie Food Items Sold As a Function of Week and Year

Figure 3 displays the number of medium calorie foods sold as a function of week and year. Analogous to the previous figure, significantly more medium calorie foods were sold over the spring of 2008 semester than the spring of 2007 semester ($p<.0001$).

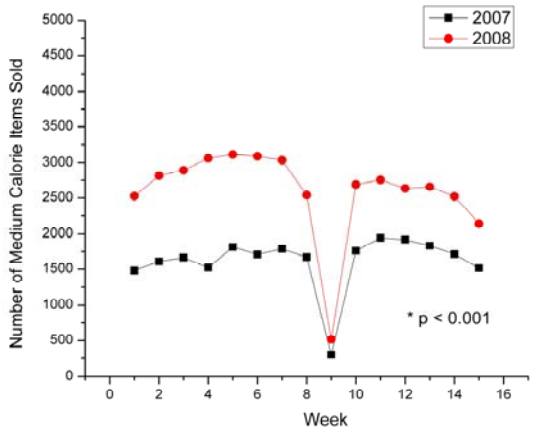

Figure 3: Number of Medium Calorie Food Items Sold As a Function of Week and Year

Figure 4 is a graph of the number of low calorie foods sold during spring 2007 and spring 2008 as a function of week. Significantly more low calorie foods were sold during the spring of 2008 than during the spring of 2007 ($p<.001$).

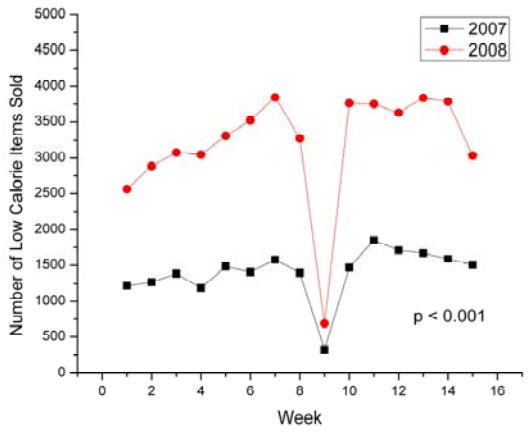

Figure 4: Number of Low Calorie Food Items Sold As a Function of Week and Year

Figure 5 is a graph of high calorie foods sold as a percent of total foods sold during spring 2007 and spring 2008 as a function of week. The graph illustrates that high calorie foods made up a significantly lower percentage of foods sold during the spring of 2008 semester than the spring of 2007 semester. It also indicates the consistency of the effects. There was no week when the percent of high calorie foods overlapped between the two years.

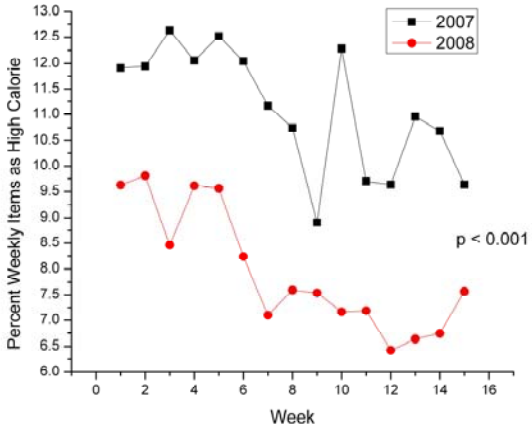

Figure 5: Percent of High Calorie Foods Sold As a Function of Week and Year

Figure 6 shows the mean weekly percent of low, medium, and high calorie foods sold. The graph indicates that while a significantly higher percentage of calorie foods were sold on average during the second year, a smaller percentage of medium and high calorie foods were sold ($p<.001$). This means that most of the increase in foods sold during the second year is a result of consumers purchasing low calorie foods rather than medium or high calorie foods.

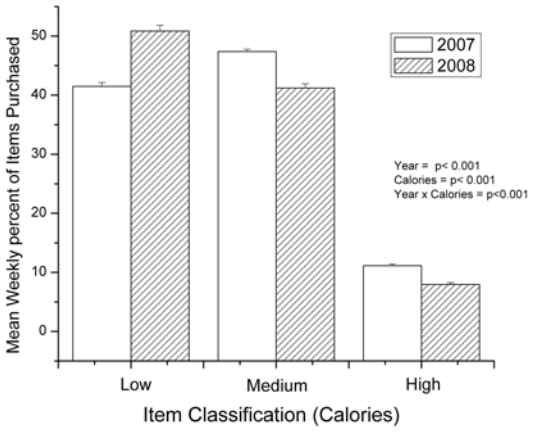

Figure 6: Mean Weekly Percent of Low, Medium, and High Calorie Foods Sold As a Function of Year

One surprising finding is illustrated in Figure 7. This figure shows that the percent of high calorie foods sold significantly declines as each spring semester progresses. A linear regression indicated that the slope for both years was different from zero. However, this decrease was not significantly different between the two years.

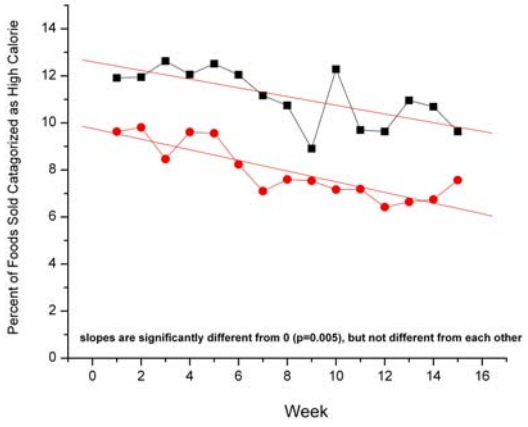

Figure 7: Percent of High Calorie Foods Sold As a Function of Week and Year

Figure 8 is a graph of high fat foods sold expressed as a percent of total foods sold during the spring of 2007 versus the spring of 2008. High fat foods made up a significantly lower percentage of foods sold during the spring of 2008 semester than the spring of 2007 semester ($p<.001$). As with calories, there was no week when the percent of high fat foods overlapped between the two years.

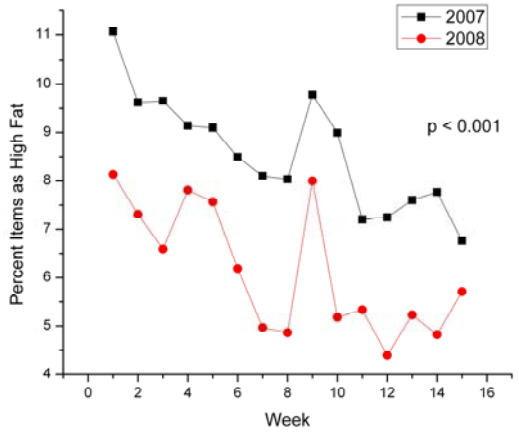

Figure 8: Percent of High Fat Foods Sold As a Function of Week and Year

Figure 9 shows foods sold with a high percent of calories from fat expressed as a percent of total foods sold as a function of week and year. Foods with a high percent of calories from fat made up a significantly lower percentage of foods sold during the spring of 2008 semester rather than the spring of 2007 semester ($p<.001$). Only during week 9, which was the week of spring break, did the percent of high percent calories from fat foods overlap between the two years.

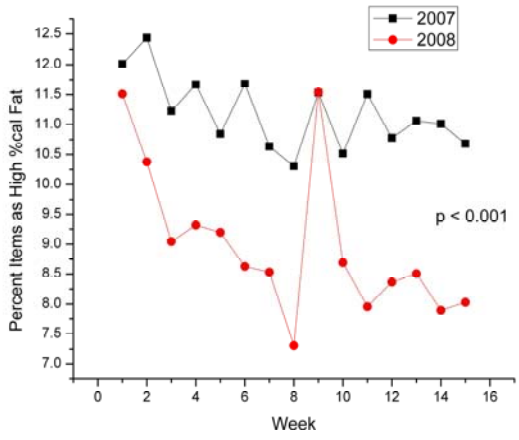

Figure 9: Percent of High Percent Calories From Fat Foods Sold As a Function of Week and Year

Figure 10 is a graph of high sodium foods sold expressed as a percent of weekly foods sold as a function of week and year. High sodium foods made up a significantly lower percentage of foods sold during the spring of 2008 semester than the spring of 2007 semester ($p<.001$). As with calories and fat, there was no week when the percent of high sodium foods overlapped between the two years.

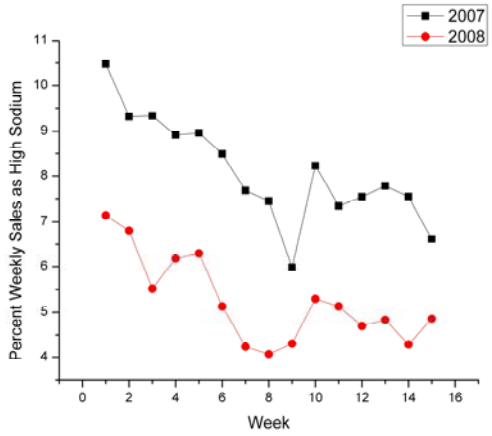

Figure 10: Percent of High Sodium Foods Sold As a Function of Week and Year

Figure 11 graphs high-fiber foods sold expressed as a percent of total foods sold as a function of week and year. Unlike the other graphs which show a decrease in an unhealthy nutrient during the second year, high-fiber foods (a healthy nutrient) also made up a significantly lower percentage of foods sold during the spring of 2008 semester than the spring of 2007 semester ($p<.001$).

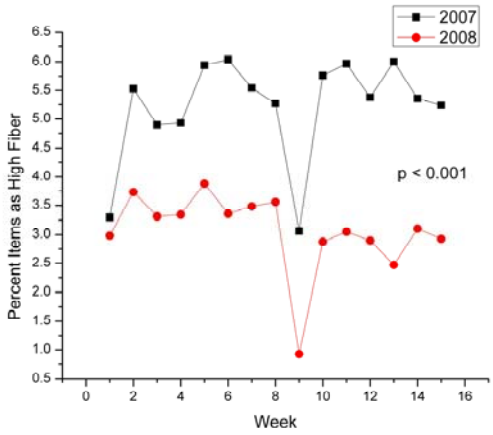

Figure 11: Percent of High Fiber Foods Sold As a Function of Week and Year

Discussion

These data results highly suggest that, contrary to the results of the literature, consumers, at least college students, not only read nutrition labels but also act on that information by purchasing healthier foods. While total sales were higher for the second year than the first, the additional foods sold mostly consisted of low calorie foods rather than high calorie foods. The significant interaction between year and calorie category of the foods indicated that the difference between foods purchased between the two years was greater in the low calorie category than the high calorie category. Furthermore, the

percentage of foods sold that were high in calories, fat, percent of calories from fat, and sodium was all lower during the second year for every single week.

Unfortunately, the results indicate that consumers purchased a lower percentage of high-fiber foods during the second year than the first. This effect may be due to consumers looking at calorie and fat information rather than fiber information on food labels. For instance, a peanut butter and jelly sandwich on whole wheat has both more calories and higher fiber content than a peanut butter and jelly sandwich on white bread. Therefore, students looking to decrease the number of calories ingested might buy the sandwich with both fewer calories and fewer grams of fiber. Nonetheless, the data suggest that consumers are reading nutrition labels when purchasing food items.

A novel finding was also that as each spring semester progresses, the percent of high calorie foods sold significantly declines. However, this decrease was not significantly different between spring 2007 and spring 2008. Therefore, this trend seems to be a result of semester fluctuations rather than of the nutrition labels. One possible explanation for the trend is that as the semester progresses, students may feel as if they have limited control over their academic grades and classes; however, one area of their lives that the students can control is their food consumption, so they seek to eat healthier and less caloric foods.

There has recently been a trend to start requiring restaurants and fast-food chains to post nutrition labels for foods served. While the Food & Drug Administration has traditionally controlled the format of nutrition labels, it has specifically given the states and local governments authority to require nutrition labeling in restaurants.[42] While

restaurants have previously been exempted from the Food & Drug Administration nutrition labeling requirements, state and local laws are beginning to require them.

For instance, H.R. 3895 in the 110th Congress, 1st Session proposed the Menu Education and Labeling Act (MEAL Act) in the House of Representatives in October 2007.[11] This act would require chain restaurants with twenty or more outlets to display nutrition information to consumers.[6] A similar act, the LEAN Act, was recently introduced in the Senate as well.[20] New York City's Board of Health also started forcing chain restaurants with fifteen or more outlets to provide calorie information to consumers.[16] Additionally, according to the National Restaurant Association, seven states, three counties, and two cities are currently considering laws that would require menu labeling in restaurants.[16] According to Pomeranz et al. (2008), there have been twenty proposed or passed menu-labeling laws so far.

However, the restaurant industry has opposed these nutrition-labeling laws. For instance, although they lost the case, the New York State Restaurant Association filed a lawsuit claiming that New York City did not have the authority to regulate nutrition disclosure.[52] Additionally, Almanza et al. (1997) surveyed research and development directors of major foodservice companies and found that a large proportion feared a potential negative effect on sales if nutrition information were provided to consumers. In the study, three additional concerns posed by the restaurant directors were the need to train employees on how to incorporate nutrition labeling into the restaurants, the lack of standardized food products, and the cost of printing nutrition information.[2] The costs of implementing these nutrition-labeling programs are estimated to cost the food industry anywhere between $8 million and $40 million annually.[22]

According to Pomeranz et al. (2008), however, “public health laws have greater potential for benefit if there is strong public health rationale underlying government action.” Therefore, before laws require nutrition labeling, research studies should determine whether consumers use those labels to purchase healthier food items. In order to require nutrition labels, the benefits of the labels should outweigh the costs obtained by the restaurant industry. Pomeranz et al. (2008) outlined three objectives that nutrition labels should achieve before the information is required in restaurants: better informed decision-making, less consumer confusion, and a decrease in the toll taken by poor diets. The present study highly suggested that consumers do engage in better decision-making of food purchases as a result of nutrition labels. However, the study did not test whether nutrition labels lead to less consumer confusion or a decrease in the toll taken by poor diets. Researchers should therefore design future studies to address these questions.

The major limitation to the study is the inability to make the conclusion that the change in buying behaviors is definitely a result of the addition of nutrition labels. We attempted to control for any other differences by comparing only foods that were offered both years. Furthermore, semester fluctuations in food purchases should have been eliminated, since we compared the food sales data from two spring semesters. However, we have confirmed with the dietician (Michele Wilbur) that while no new low calorie, low fat, or low sodium foods were introduced in the spring of 2008, three new food items were added in the fall of 2007. However, it is unlikely that three new foods out of almost one hundred total items caused such a significant change in the purchasing behavior of Cornell consumers. The only other difference between the two years was a price increase for some of the foods in the fall of 2007, which may have had a subsequent effect on the

foods purchased in the spring of 2008. Unfortunately, we do not currently know which foods underwent this price increase. Therefore, while it is likely that the nutrition labels led to the change in food purchases between the two years, it is possible that the results were due to effects we were unable to measure. On the other hand, these statistics may represent the first definitive data suggesting that the addition of food labels in a dining situation may produce significant changes in consumer behavior towards the purchasing of healthier foods.

Another limitation of the present study was that Cornell dining constantly changed the ingredients and recipes of the foods throughout each semester. Although multiple versions of each nutrition label were provided to consumers during the study period, only one version was used in the study to determine nutrient content of each food. However, while the recipes and nutrition labels did fluctuate throughout the semesters, they remained relatively stable and did not vary considerably.

These analyses included data collected from all dining units at Cornell. It is possible, therefore, that labeling may have had a greater effect in one type of dining hall and not in another. Clearly, future studies may, therefore, want to determine whether nutrition labeling has distinct effects on students, faculty members, and college visitors.

A third limitation is that some consumers may be trying to loose weight while some may be trying to gain weight, which would cancel out in aggregate data. Therefore, the sales data may not reflect individual consumer decisions. The present study assumed no difference in the number of consumers who wanted to lose weight in 2008 was not different than in 2007. Future studies may therefore want to use sales data from individual consumers instead of using aggregate data or link the aggregate data to

individual consumers. Fourth, nine-hundred forty data points were excluded because of incomplete data, which may have affected the results. However, considering that only 10.97% of the data points were excluded, it is unlikely that these had a considerable effect on the outcome of the study. Fifth, a small written comment was made on the side of each food container stating that salad dressing nutrient information was not included in the nutrition label. However, it is unknown whether consumers read this comment and whether this affected sales data.

In addition to the present study, most nutrition label studies have overlooked factors affecting food choice, such as cost, taste, and convenience. Future studies need to take these factors into account when determining how consumers use nutrition labels, because the most nutritious foods are those that are often the cheapest and tastiest.

Some of the background research suggested that nutrition education programs in combination with nutrition labels may help consumers to choose healthier foods.[40,5,14,33,43,30,45] The Food & Drug Administration has started a program for children and teenagers, called *Spot the Block*, that teaches them nutrition education and how to use nutrition labels to make health food choices.[49] The program runs both television commercials and a website through the Cartoon Network.[49] The Food & Drug Administration is also in the process of developing a complementary campaign that will teach parents how to help their children use nutrition labels.[49] The Department of Health and Human Services has similarly prepared The Food Label Education Program for high school students. In this program, teachers are given handouts, charts, and worksheets that educate students on how to incorporate nutrition labels into their daily diets.[38] While it is still unclear exactly how nutrition labels help consumers to choose healthier foods, these

nutrition education programs may serve as a good forum, in the meantime, to teach consumers how the labels can fit in their daily lives.

Appendix I: Mean, number, and standard deviation of food items by nutrient and category

Calories:	Mean	N	Standard. Deviation
Category 1	239.0801	10942	103.9994
Category 2	544.8351	12401	102.6153
Category 3	859.4067	4180	70.00005
Total	471.0546	27523	237.7833

Fat:	Mean	N	Standard Deviation
Category 1	10.34385	13801	5.701405
Category 2	28.26313	11325	5.346191
Category 3	45.51564	2397	5.545933
Total	20.78031	27523	12.71545

Sodium:

	Mean	N	Standard Deviation
Category 1	444.1057	15302	306.7489
Category 2	1285.389	9847	265.3709
Category 3	2360.126	2374	314.5146
Total	910.3613	27523	662.2121

Percent Calories From Fat:

	Mean	N	Standard Deviation

Category 1	18.6723	7256	8.967617
Category 2	41.15339	17121	7.285043
Category 3	61.62386	3146	8.622179
Total	37.56647	27523	15.19823

Fiber:

	Mean	N	Standard Deviation
Category 1	2.907837	20084	1.621729
Category 2	7.311426	4306	1.206196
Category 3	12.66613	3133	1.882803
Total	4.70759	27523	3.631091

References

1. Aaron, J. I., Evans, R. E., & Mela, D. J. (1995). Paradoxical effect of a nutrition labeling scheme in a student cafeteria. *Nutrition Research, 15*(9), 1251-1261.
2. Almanza, B. A., Nelson, D., & Chai, S. (1997). Obstacles to nutrition labeling in restaurants. *Journal of the American Dietetic Association, 97*(2), 157-161.
3. Anderson, A. S., Freeman, J., Stead, M., Wrieden, W. L., & Barton, K. L. (2008). Consumer views on portion size guidance to assist adult dietary choices [Abstract]. *The British Dietetic Association, 21* 373-406.
4. Blake, A. J., & Melton, R. A. (1992). Dimensions of knowledge attitudes and behavior of diet and cardiovascular disease based on principles of diet and disease and behavior change model criteria. *Nutrition Research, 12*(1295), 1313.
5. Boulanger, P. M., Perez-Escamilla, R., Himmelgreen, D., Segura-Millan, S., & Haldeman, L. (2002). Determinants of nutrition knowledge among low-income latino caretakers in hartford, connecticut. *Journal of the American Dietetic Association, 102*(7), 978-981.
6. Burton, S., Creyr, E. H., Kees, J., & Huggins, K. (2006). Attacking the obesity epidemic: The potential health benefits of providing nutrition information in restaurants. *American Journal of Public Health, 96*(9), 1669-1675.
7. Burton, S., & Creyer, E. H. (2004). What consumers don't know can hurt them: Consumer evaluations and disease risk perceptions of restaurant menu items. *The Journal of Consumer Affairs, 38*(1), 121-145.
8. *California institutes menu-labeling law for chain restaurants.* (2008). Retrieved 10/15, 2008, from http://www.rwjf.org/childhoodobesity/digest.jsp?id=8673&c=EMC-ND138
9. *A case study of california's menu labeling legislation.* (2008). Retrieved 10/06, 2008
10. *Consumer research on food labels.* (2004). Retrieved 10/25, 2008, from http://www.cfsan.fda.gov/~lrd/ab-label.html
11. Menu Education and Labeling Act, H.R. 3895, 110th Congress 1st SessionCong. (2007).

12. Drewnowski, A., & Fulgoni III, V. (2008). Nutrient profiling of foods: Creating a nutrient-rich food index. *Nutrition Reviews, 66*(1), 23-39.
13. *Fast food chain to post calorie information on menus.* (2008). Retrieved 10/15, 2008, from http://www.rwjf.org/childhoodobesity/digest.jsp?id=8686&c=EMC-ND138
14. Fitzgerald, N., Damio, G., Segura-Perez, S., & Perez-Escamilla, R. (2008). Nutrition knowledge, food label use, and food intake patterns among latinas with and without type 2 diabetes. *Journal of the American Dietetic Association, 108*(6), 960-966.
15. Food labels benefit consumers and dietetics professionals.(1999). *Journal of the American Dietetic Association, 99*(1), 53.
16. Frumkin, P. (2008, February 4, 2008). Revised NYC menu-labeling law reignites fierce debate. *Nation's Restaurant News*
17. *Guidance for industry: A labeling guide for restaurants and other retail establishments selling away-from-home foods.* (2008). Retrieved 10/01/08, 2008, from http://www.cfsan.fda.gov/~dms/2lg-toc.html
18. *Guide to nutrition labeling and education act (NLEA) requirements.* (1995). Retrieved 10/01/08, 2008, from http://www.fda.gov/ora/inspect_ref/igs/nleatxt.html
19. Hasler, C. M. (2008). Health claims in the united states: An aid to the public or a source of confusion? *The Journal of Nutrition, 138*, 1216S-1220S.
20. Hensley, S., & Donohue, M. (2008, National restaurant association statement about introduction of LEAN act in congress. *National Restaurant Association*
21. Hold the fries and the district menu labeling.(2007, May 6, 2007). *Restaurant Association Metropolitan Washington,* B08.
22. Jacoby, J., Chestnut, R. W., & Silberman, W. (1977). Consumer use and comprehension of nutrition information. *Journal of Consumer Research, 4*, 119-127.
23. Kral, T. V. E., Roe, L. S., & Rolls, B. J. (2002). Does nutrition information about the energy density of meals affect food intake in normal-weight women? *Appetite, 39*, 137-145.
24. Kristal, A. R., Hedderson, M. M., Patterson, R. E., & Neuhauser, M. L. (2001). Predictors of self-initiated, healthful dietary change. *Journal of the American Dietetic Association, 101*(7), 762-766.

25. Krukowski, R. A., Harvey-Berino, J., Kolodinsky, J., Narsana, R. T., & DeSisto, T. P. (2006). Consumers may not use or understand calorie labeling in restaurants. *Journal of the American Dietetic Association, 106*(6), 917-920.
26. Kristal, A. R., Levy, L., Patterson, R. E., Li, S. S., & White, E. (1998). Trends in food label use associated with new nutrition labeling regulations. *American Journal of Public Health, 88*(8), 1212-1215.
27. LeGault, L., Brandt, M. B., McCabe, N., Adler, C., Brown, A., & Brecher, S. (2004). Food label and package survey: An update on prevalence of nutrition labeling and claims on processed, packaged foods. *Journal of the American Dietetic Association, 104*(6), 952-957.
28. Levy, A. S., & Fein, S. B. (1998). Consumers' ability to perform tasks using nutrition labels. *Journal of Nutrition Education, 30*(4), 210-218.
29. Levy, A. S., Fein, S. B., & Schucker, R. E. (1996). Performance characteristics of seven nutrition label formats. *Journal of Public Policy & Marketing, 15*(1), 1-15.
30. Levy, A. S., Mathews, O., Stephenson, M., Tenney, J. E., & Schucker, R. E. (1985). The impact of a nutrition information program on food purchases. *Journal of Public Policy & Marketing, 4*(1), 1-13.
31. Mackison, D., Anderson, A., & Wrieden, W. (2008). A review of consumers' use and understanding of nutrition information on food labels. *67*(E215).
32. *Make your calories count: Use the nutrition facts label for healthy weight management.* (2006). Retrieved 9/1, 2008, from http://www.cfsan.fda.gov/~ear/hwm/labelman.html
33. Marietta, A. B., Welshimer, K. J., & Anderson, S. L. (1999). Knowledge, attitudes, and behaviors of college students regarding the 1990 nutrition labeling education act food labels. *Journal of the American Dietetic Association, 99*(4), 445-449.
34. *Menu labeling, trans fat ban approved by the board of health.* (2007). Retrieved 10/06, 2008, from http://www.metrokc.gov/Health/news/07071901.htm
35. Moorman, C., & Matulich, E. (1993). A model of consumers' preventive health behaviors: The role of health motivation and health ability. *Journal of Consumer Research, 20*(2), 208-228.

36. Nayga, R. M. J. (2000). Nutrition knowledge, gender, and food label use. *The Journal of Consumer Affairs, 34*(1), 97-110.
37. Neuhouser, M. L., Kristal, A. R., & Patterson, R. E. (1999). Use of food nutrition labels is associated with lower fat intake. *Journal of the American Dietetic Association, 99*(1), 45-50.
38. *The new food label: There's something in it for everybody.* Retrieved 9/1, 2008, from http://ific.org/publications/other/upload/What-s-New-About-the-New-Food-Label-Poster.pdf
39. *Nutrition labeling.* (2008). Retrieved 10/25/08, 2008, from http://www.americanheart.org/presenter.jhtml?identifier=4631
40. Petrovici, D. A., & Ritson, C. (2006). Factors influencing consumer dietary health preventative behaviours. *BMC Public Health, 6*(222), 1-12.
41. Philadelphia passes tough new labeling requirements for chain restaurant menus, rejects LEAN act leniency.(2008, *NowPublic.Com*
42. Pomeranz, J. L., & Brownell, K. D. (2008). Legal and public health considerations affecting the success, reach, and impact of menu-labeling laws. *Government, Politics, and Law, 98*(9), 1578-1582.
43. Rigby, P. M., & Tommis, Y. (2008). Improving food purchasing choices through increased understanding of food labels, using itemized till receipts to measure these changes [Abstract]. *The British Dietetic Association, 21* 373-406.
44. Rothman, R. L., Housam, R., Weiss, H., Davis, D., Gregory, R., Gebretsadik, T., et al. (2006). Patient understanding of food labels: The role of literacy and numeracy. *American Journal of Preventative Medicine, 31*(5), 391-397.
45. Russo, J. E., Staelin, R., Nolan, C. A., Russell, G. J., & Metcalf, B. L. (1986). Nutrition information in the supermarket. *Journal of Consumer Research, 13*(1), 48-70.
46. Satia, J. A., Galanko, J. A., & Neuhouser, M. L. (2005). Food nutrition label use is associated with demographic, behavioral, and psychosocial factors and dietary intake among african americans in north carolina. *Journal of the American Dietetic Association, 105*(3), 392-402.

47. *Small business exemption notification program.* (2007). Retrieved 9/1, 2008, from http://www.cfsan.fda.gov/~dms/cfsup158.html

48. Somerick, N., & Weir, L. (1998). How public relations professionals can use food labels as effective communication tools. *Public Relations Review, 24*(3), 377-385.

49. *Spot the block: Using the nutrition facts label to make healthy food choices -- A program for tweens.* (2008). Retrieved 10/25, 2008, from http://www.cfsan.fda.gov/~dms/spotov.html

50. Teisl, M. F., & Levy, A. S. (1997). Does nutrition labeling lead to healthier eating? *Journal of Food Distribution Research, 28*(3), 18-27.

51. Thedford, K. (2005). Food labels: Who is being educated? *Journal of the American Dietetic Association, 105*(3), 402-403.

52. A turn for the worse on menu labeling.(2008, June 07, 2008). *Nation's Restaurant News*

53. *What is obesity.* Retrieved 11/15, 2008, from http://www.obesity.org/information/what_is_obesity.asp

54. Wootan, M. G. (2007). Need for and effectiveness of menu labeling. *Journal of the American Dietetic Association, 107*(1), 33-34.

55. Zallocco, R. L. (1990). Restaurant menu labeling: Impact of nutrition information on entree sales and patron attitudes. *Journal of Health Care Marketing, 10*(4), 78-79.