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Nutrition Labels on Food Purchasing Decisions:
A field experiment with scanner data

by Joshua P. Berning, Hayley H. Chouinard,
and Jill J. McCluskey

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University of Connecticut
Department of Agricultural and Resource Economics

Measuring the impact of nutrition labels on food purchasing decisions: A field experiment with scanner data

Joshua P. Berning
University of Connecticut

Hayley H. Chouinard
Washington State University

Jill J. McCluskey
Washington State University

Abstract: A simple experiment is used to examine the effect of grocery store nutrition labels on the sales of microwave popcorn in the East Bay area of California. Using an incomplete demand system we estimate the impact of the nutrition labels on sales of healthy (products that merit a nutrition label) and unhealthy (products that do not merit a nutrition label) microwave popcorn. Contrary to expectations, we find that nutrition labels *decrease* sales of healthy popcorn and *increase* sales of unhealthy popcorn across all stores. We speculate that nutrition labels on popcorn may signal unwanted product characteristics such as undesirable taste. Our findings highlight unintended effects created by nutrition labels. In terms of public welfare, it is important to consider not just the content of private industry nutrition labels but the effect they have on consumer behavior.

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Introduction

Shoppers are exposed to an ever growing number of different nutrition labels in grocery stores. Manufacturers display nutrition claims such as *low fat*, *low calorie* or *zero transfat* on product packaging in an attempt to draw favorable attention to their products. Certain manufacturers even create their own proprietary labels designed to help shoppers evaluate healthy products within their brand, (e.g. Pepsi's *Smart Choice* and Kraft's *Sensible Solution*). Health advocacy groups allow the presentation of their own nutrition labels on acceptable products. Examples include the American Heart Association's *heart-check* label and Weight Watchers grocery store label. Some grocery store chains offer their own proprietary nutrition labels which they affix near products that meet their own definition of healthy[1]. Such nutrition labels are intended to reduce search costs for shoppers who want to identify products with specific qualitative characteristics. For example, a diabetic may rely on a nutrition label identifying *no sugar added* while a hypertensive person may focus on *low sodium* labels. A manufacturer's proprietary label may direct a shopper to healthier alternatives within their product line. In the case of an American Heart Association label, a shopper may find a product more conducive to maintaining their cholesterol levels. As such, nutrition labels may complement products by providing notice to favorable quality characteristics (Becker and Murphy 1993).

As shoppers become more experienced with nutrition labels, however, they may associate certain nutrition labels with other quality characteristics that are not explicitly described by the nutritional information. Shoppers could use nutrition labels to identify products that *do not* possess nutritional characteristics negatively associated with taste. In selecting an ice cream, for example, a consumer may view a *low fat* nutrition claim as an indication of inferior taste relative to other ice cream. Similar examples are available with other snack food items. In this case, nutrition labels still assist the consumer in identifying preferred products, which makes them better off in an economic sense (Teisl, Bockstael and Levy 2001). However, the nutrition label may lead to the purchase of products that are relatively unhealthier which would be both an unexpected and undesirable effect from a policy standpoint.

We conducted an experiment to examine the effect of nutrition labels that highlight specific nutrients on microwave popcorn sales. We affixed nutrition labels on grocery store shelves below different types of microwave popcorn in five stores in the East Bay area of California for one month. Specifying an incomplete demand system, we estimate the impact of the nutrition labels on sales of healthy (products that merit a nutrition label based on Food and Drug Administration standards) and unhealthy (products that do not merit a nutrition label) microwave popcorn. Contrary to the intended effect of the nutrition labels, we find that nutrition labels *decrease* sales of healthy popcorn and *increase* sales of unhealthy popcorn across all stores.

Nutrition labels that identify healthier microwave popcorn make it easier for consumers to purchase those healthier goods. At the same time, however, popcorn consumption may not be a consideration in an overall approach to a healthy lifestyle. That is, consumers may allow consumption of treats for which they do not consider the nutritional content. Nutrition labels on popcorn may have no effect or may even signal unwanted characteristics such as undesirable taste. It may be that shoppers infer from nutrition labels other quality characteristics besides nutritional content.

Our findings highlight an important issue that has not been extensively researched in food marketing, the unintended effects created by nutrition labels. While nutrition labels are intended to complement healthier products by bringing favorable notice to them, in this research we find that the labels tend to reduce sales of the product. While we do not directly measure the effect of the nutrition labels on consumer purchase intentions, finding such an effect on aggregate sales is relevant to both policy and industry. Marketing professionals and government agencies need to consider the unintended consequences of advertising nutrition. It is especially important for policy makers to consider the effect of industry nutrition labels on consumer behavior and not just whether their content meets FDA standards.

Preferences for Food Quality

While it appears reasonable to assume that nutrition information will positively complement a product, it could also be the case that nutrition information would have a negative effect on the perception of a food product. Consider a utility expression in which utility comes from consuming food items *x* and other goods *z*. In addition, utility is derived from product information *i* which describes the vectors of goods *x* and *z* such that:

$$U\left(x, z, i_x, i_z\right) \qquad (1)$$

Included within the broad category of product information are such things as media advertising, word of mouth information and the focus of this study, nutrition information which is often delivered using nutrition labels. As expected, utility is increasing at a decreasing rate in the vectors *x* and *z*: $U_x, U_z > 0, U_{xx}, U_{zz} < 0$. The effect of information on utility can be decomposed into two terms: $dU/di = \partial U/\partial i + \partial U/\partial x \cdot \partial x/\partial i$. The first term on the right hand side is the direct impact of product information on utility and is unambiguously positive because consumers are always better with more product information, good or bad. The utility from information is also increasing at a decreasing rate due to search costs: $U_{i_x}, U_{i_z} > 0, U_{i_x i_x}, U_{i_z i_z} < 0$. The second half of the second term, $\partial x/\partial i$, is the indirect effect of nutrition information which may be positive or negative depending on the relationship of the product and the product information. If the information brings favorable notice to the product, as in the Becker and Murphy argument, the information will complement the vectors of consumed goods and the cross partial derivative of the marginal utility of *x* with respect to information will be positive: $\partial U/\partial x \cdot \partial x/\partial i > 0$. In such a case, the favorable advertising provided by a nutrition label enhances the marginal utility of the consumed product. As an example, if a consumer is searching for a product that is low sodium among a large number of products, a low sodium label increases the marginal value of the product among other non-labeled or high sodium products.

It may be the case, however, that nutrition labels do not favorably complement the product they describe. It could be that a nutrition label highlights characteristics that negatively effect the perception of the product, as in the example of *lowfat* ice cream. In this case, the cross partial derivative of the marginal utility of *x* with respect to information would be negative: $\partial U/\partial x \cdot \partial x/\partial i < 0$. This would imply that the nutritional information decreases the marginal value of the consumptive product, *x,* which would likely lead to reduced consumption of *x* by a rational consumer.

It will always be the case, however, that $\partial U/\partial x \cdot \partial x/\partial i < \partial U/\partial i$ because utility is strictly increasing in information. While shoppers might abstain from purchasing a product after observing a nutrition claim, they are still better off being allowed to make a more informed decision. In this sense, nutrition labels do not have to direct shoppers to select healthy choices to be beneficial. While this may be a favorable outcome in terms of public policy, nutrition labels can also increase consumer welfare by helping shoppers to identify preferred products (Teisl, Bockstael and Levy 2001). Obviously the long-term implications of diet quality on quality of life are important to consider. In terms of the benefits from decreasing shopper search costs, however, the nutritional quality of food is of no consequence. Shoppers are better off if they can more easily identify the products they want to consume, whether that is a piece of fruit or a slice of cake.

While a majority of research on nutrition labels identifies their positive effects on consumer behavior, there are several food quality studies which suggest that product labels which describe nutritional content could also negatively impact consumer perception of product quality and taste. In their examination of consumer acceptance of soy products, Wansink and Park (2002) find that soy labels negatively bias taste perceptions and attitudes towards foods perceived to contain soy but without any soy. Solheim (1992) finds that information about fat content influences the response to different types of sausage, regardless of the actual fat content. Aaron, Mela and Evans (1994) reports similar effects with fat spread. Wardle and Huon (2000) find children rate drinks with “healthy labels” as less pleasant and are less likely to ask their parents to buy them. Baranowski et al (1993) summarizes this negative correlation by stating the conventional wisdom: if a food tastes good, it must not be good for me and if a food tastes bad, it is probably good for me.

The effect of nutrition labels on perceived taste appears to differ among products. For example, Kahkonen, Tuorila and Rita (1996) find that nutritional content of food affects hedonic ratings with fat spreads. Whereas Kahkonen, Tuorila and Lawless (1997) find no effect with yogurt, and note that yogurt is already assumed to be low fat by consumers. This difference may not be strictly due to perceived differences of healthy and unhealthy foods. For example, Shepherd et al (1992) find that information regarding fat and sugar content affect consumer responses to flavored milk. Whereas one might expect nutrition labels to increase purchases of healthy products, nutrition labels may also direct consumers to select products that they associate with their preferred taste, which may be relatively unhealthy.

Experiment

As part of an experiment, we affixed nutrition labels on grocery store shelves below boxes of microwave popcorn in five stores belonging to the same national chain in the East Bay area of California for four consecutive weeks beginning October 10, 2007. We used a different set of labels identifying specific nutrients in each store (table 1). For example, store one had labels that identified products that were low calorie, low fat or low calorie and low fat, for a total of three different labels. Whereas store two only had one label that identified products that were low fat. For all the labels, the nutrition claims were based on Food and Drug Administration (FDA) standards. In store three, the low fat claim was followed by a reference to the FDA standards. Six different types of labels were used in store five[2]. An example of three of the labels is provided in figure 1. In addition to the treatment stores, we observe the same products in five control stores in the East Bay area.

The stores differ in size as well as the number of products that received labels (table 2). Store five had the most labeled products both in percentage terms and total number. Store three had the lowest number of labeled products as well as the lowest number of total products, while store two had the lowest percentage of products labeled. The stores also differ in terms of zip code demographics.

Empirical Methods and Data

We examine the impact of nutrition labels on popcorn sales by estimating a linear-quadratic ideal demand system (LQ-IDS) developed by LaFrance (1990, 2004) which is linear in income and quadratic in prices. The LQ-IDS model is consistent with economic theory of consumer behavior, allowing for the assumption of a representative consumer when using aggregate sales data. The specification of an incomplete demand system avoids the need to assume weak complementarity or two stage budgeting. With an incomplete demand system, no adding up restriction is necessary which removes the need to drop an equation.

The model is derived from an expenditure function that is also linear in income and quadratic in prices and satisfies integrability, allowing for exact welfare measures:

$$e(p,\tilde{p},s,u) = \alpha' p + p' As + 0.5 p' Bp + \theta(\tilde{p},s,u) e^{\gamma' p} . \qquad (2)$$

The term $\theta(\tilde{p},s,u)$ is the constant of integration and is increasing in utility, *u*, but otherwise cannot be identified. Based on equation 2, the indirect utility function can be solved as:

$$v(p,\tilde{p},m,s) = (m - \alpha' p - p' As - 0.5 p' Bp) e^{-\gamma' p} . \qquad (3)$$

The system of demand equations for the LQ-IDS model can be derived from equation (2) as:

$$q = \alpha + As + Bp + \gamma(m - \alpha' p - p' As - 0.5 p' Bp) , \qquad (4)$$

where q is the vector of quantities, α and γ as vectors of parameters, A as a matrix of parameters associated with a vector of demographic variables, s, and B as a symmetric matrix of parameters. In this system, homogeneity is satisfied by normalizing all prices by the numeraire good, which is all other goods in a complete system of demand equations. In this particular estimation, the vectors of prices p and income m are normalized using a non-food consumer price index for the Western United States, given as $\tilde{p}$.

For the purposes of this research, we aggregate all popcorn UPCs into two categories, healthy or unhealthy, where healthy is defined as products that merit a nutrition label based on FDA standards. Weekly total sales and total quantity of all popcorn UPCs were compiled from the first week of 2006 to the fifth week of 2008 for each of the ten stores. Prices are calculated as total sales by total quantity. From this, weekly quantities and prices for healthy and unhealthy popcorn are calculated as weighted weekly averages. Estimates of weekly income from 2006-2008 are calculated for each store as well. To do this, zip code level per-capita income for each store is taken from the 1999 U.S. Census. To generate monthly per-capita income we multiply the 1999 per-capita income by the ratio of monthly state level personal income for any time month in 2006-2008 to monthly state level personal income in 1999. Weekly personal income by zip code is then interpolated from the monthly values. Although this estimate is an inexact measure of income, it captures changes in the overall state economy over the two-year period as well as income differences between the store zip codes.

Income endogeneity is tested following the procedure outlined in Villas-Boas and Winer (1999). Income is first regressed on all the variables and then the residuals of this estimation are included in the system of demand equations as an explanatory variable. In this analysis, the residuals are not significant suggesting that income is exogenous. Subsequently, income is treated as an exogenous variable throughout the study. We tested and found prices to be endogenous. Lacking data on potential instruments, we follow Villas-Boas and Winer and use lagged prices as instruments.

To examine the impact of nutrition labels on the sales of healthy and unhealthy popcorn, a dummy variable is included in the demand system to indicate if a nutrition label was present. This approach attempts to capture the effect of *any* type of nutrition label on demand. That is, the effect of a *low fat* label is grouped in with the effect of the *low calorie* label as well as all the other different labels. Fixed effects are included for each store location as well as a time trend and seasonal effects. Although this demand system is incomplete in the sense that only the products of interest are estimated, the demand system includes information regarding all products via the normalization of the non-food CPI and no equations are dropped. As such, the system of demand equations is estimated using full-information maximum likelihood (FIML). As point out by Dhar, Chavas and Gould (2003) FIML estimates are asymptotically efficient and this efficiency does not depend on the choice of instruments as with three-stage least squares.

Results

We first estimate the LQ-IDS model without specifying the effects of the nutrition labels to gain an initial approximation of the demand system and to calculate own and cross price elasticities. While the model is biased due to an omission of the label effect, the bias is minimal and has a negligible effect on the elasticity measures. The results of the base model (table 3) indicate that the own price terms are highly significant, while the cross-price terms are significant only at the 90 percent level. The income parameters are not significant for the healthy popcorn but are significant for the unhealthy popcorn. The unhealthy popcorn appears to have more seasonal difference, with sales increasing in the Fall. Store specific fixed effects are not included for simplicity.

Using average price and quantity values from each store, the elasticity measures show that the healthy popcorn is elastic in most stores, with the exception of store 5 where it is inelastic (table 4). Unhealthy popcorn is less elastic in all stores, except store 5 where it is elastic. The low cross-price elasticity suggests that there is not a large amount of substitution between healthy and unhealthy popcorn given changes in price.

We next estimate a model including a dummy variable to capture the effect of providing a nutrition label on the grocery store shelves below the popcorn (table 5). This model examines the general effect of nutrition labels on the demand for healthy and unhealthy microwave popcorn and implicitly treats shoppers as completely responsive to the provision of product information. When a nutrition label is provided, the model assumes that consumer purchases will respond. While the nutrition label always makes the consumer better off, the allocation of expenditures may respond in different ways. If the nutrition label positively complements the product, the marginal effect of the label positive and there should be an increase in purchases; if the nutrition information negatively complements the product, the marginal effect of the label negative and we should expect a decrease in purchases. We find that across all stores while the nutrition labels are present, sales for healthy popcorn decreases by roughly 5 ounces (-5.58) and sales for unhealthy popcorn increases by roughly 7 ounces (7.53), although the latter effect is only significant at the 80 percent level.

The change in sales during the treatment period could indicate that sales of healthy products decreased and unhealthy products increased. At the same time, because the demand model accounts for price changes, it could be that the sales of healthy popcorn stayed the same despite a price decrease. Likewise unhealthy popcorn sales may have stayed the same despite a price increase. We examine the sales of each store to find how sales have shifted. Specifically, we compare the average sales during the treatment and non-treatment period (table 6). In all of the stores, except stores three and ten, the total average sales of popcorn were lower during the treatment period (column 1). In terms of healthy popcorn, the average price and sales are lower during the treatment period in three of the treatment stores (stores one, two and four) and one of the non-treatment stores (store seven). This indicates that even with a lower price, sales dropped during the treatment period for healthy popcorn. This is consistent with a leftward shift or a rotation in demand. As defined in Chouinard et al (forthcoming) a shift in demand can be calculated as:

$$\frac{\partial q_h}{\partial s} = a_h - \gamma_h \left(a_h \cdot p_h + a_h \cdot p_u \right)$$

Whereas a rotation is:

$$\frac{\partial^2 q_h}{\partial p_h \partial s} = -\gamma_h a_h$$

In the above expressions, the subscript *h* and *u* are for healthy and unhealthy, *s* is an element in the vector **s** described in equation (4) and represents the nutrition label, and *a* is an element of the **A** matrix. Inserting the estimated values from the model, the change in healthy popcorn sales appears to be consistent with a shift in the demand curve.

For eight of the stores, the price of unhealthy popcorn is higher and the sales are lower. In store ten, the price is lower and the sales are higher. Interestingly, in store three, the sales are higher even though the price is also higher. While these values are all average values, they identify how sales shift during the treatment period.

Looking at total sales of healthy and unhealthy popcorn for all stores, there is a steep increase in sales in the last week of the experiment, almost entirely attributed to an increase in the sales of unhealthy popcorn (figure 2). Although this increase in sales in the last week is only present in three of the treatment stores and two of the non-treatment stores, we are not able to identify if this sharp increase is due to some unidentified marketing effect. To control for potential unidentified marketing effects in this final week of the treatment, we remove that week from the treatment sample and test if the label effect is significant for the remaining three weeks. The sales of healthy popcorn are still significantly negative (-8.2), whereas the effect on the sales of unhealthy popcorn is no longer significantly different during the experimental time period. While this supports the finding that nutrition labels lead to a reduction in sales of healthy popcorn, it is not clear if the increase in unhealthy popcorn is strictly due to some unknown promotion, the nutrition labels or a combination of the two. Without interviewing the shoppers, there appears to be no viable method to discriminate the effects.

To examine post treatment sales, we add a dummy variable to identify the post treatment period (table 7). After the treatment period the sales of healthy popcorn are still significantly lower than pre-treatment sales (-5.37), and the treatment period effect is still highly significant as well (-8.35). Unhealthy popcorn sales are higher post treatment at roughly the 80 percent level, but now the treatment period is significant at approximately the 90 percent level. This could indicate a lingering impact of the nutrition label on the sales of popcorn or it could identify a shift in sales due to some unidentified variable. The post experiment data only lasts 6 weeks after the experiment and does not allow us to examine how sales change further beyond that period.

Welfare Measures

Compensating variation is often used to measure the welfare effects of exogenous events, for example, changes in tax policy. This measure may not accurately capture the welfare effects generated from information regarding product quality. In terms of compensating variation (CV), a consumer who receives nutrition information and therefore alters their consumption may appear worse off than a consumer who receives no information and makes no changes to their consumption. The conclusion would be that nutrition information makes consumers worse off, which is inaccurate. We examine the welfare effects from the nutrition labels based on methods developed by Foster and Just (1989). They demonstrate that the appropriate welfare measure for the effects of product quality information is the difference between the compensating surplus (CS) and compensating variation. They define compensating surplus as the payment necessary to make a consumer just as well off after they receive information about product quality and are *not* allowed to adjust their consumption. They define this difference as the cost of ignorance (COI). Teisl, Bockstael and Levy later describe this in terms of nutrition labels as the value of information (VOI).

The calculations for CS, CV and COI (CS-CV) are given as

$$CS = e(p_1, U_0, \theta_1) - m_0 + (p_0 - p_1)x_0,$$

$$CV = e(p_0, U_0, \theta_1) - m_0$$

and

$$COI = CS - CV = e(p_1, U_0, \theta_1) + (p_0 - p_1)x_0 - e(p_0, U_0, \theta_1)$$

In the above, θ describes the probability distribution of product quality where the subscript 0 represents uncertainty about product quality and 1 represents knowledge of product quality where the distribution degrades to one, represented by θ_1. The provision of a nutrition label is interpreted as going from uncertainty (state 0) to certainty (state 1). Utility under a state of no information is then U_0. Prices and quantities prior to the provision of nutrition labels are p_0 and x_0, respectively and m_0 is income. The price p_1 represents the price necessary for compensated demand to remain equal to initial consumption *after* arriving at the quality distribution θ_1; that is, $h(p_1, U_0, \theta_1) = x_0$, where h represents the Hicksian demand function.

We calculate the COI in terms of the LQ-IDS model using equations 2-4 for each of the five stores based on the results of the dummy variable model (table 8). Given the non-linear specification of the LQ-IDS model, the value of p_1 is numerically approximated. In each store, the price required to prevent any changes in consumption after the labels are provided are lower for the healthy popcorn and higher for the unhealthy popcorn. For example, in store one, the price of healthy popcorn would have to have been reduced on average from $0.207 per ounce to $0.193 per ounce to prevent shoppers from reducing their consumption of healthy popcorn and the price of unhealthy popcorn would have to have increased on average from $0.089 per ounce to $0.094 per ounce to prevent consumers from increasing their consumption of unhealthy popcorn. While these represent average values for the various types of popcorn, the implications are that nutrition labels motivate changes in consumption and changes in price are necessary to counter those effects.

On average for all stores, the compensating surplus measure is around -0.45 and the compensating variation is around -0.50. The negative CV value suggests that the change in perceived quality is welfare improving and that income would have to be reduced by -0.50 to make consumers as well off as before the nutrition labels were provided. At the same time, if consumers could not adjust their purchases after the nutrition labels were provided, an income reduction of -0.45 would make them as well off as before the nutrition labels.

The resulting COI estimate in each store is on average around $0.056. Using a first-order Taylor-series expansion on this estimate we calculate the 90 percent confidence intervals (Dorfman, Kling and Sexton 1990). Based on a normal distribution, the estimated value if no different from zero[3]. Although the nutrition labels effect quantity demanded, the consumer welfare measure is insignificant. The insignificant value of the COI may be attributed to a lack of concern that shoppers have about the nutritional content of microwave popcorn. If shoppers were coerced using prices into buying popcorn with lower perceived quality (in this case, the healthier popcorn), they would not necessarily be worse off.

Conclusions

We find that positive nutrition labels affixed on grocery store shelves below microwave popcorn tend to decrease purchases of microwave popcorn that merit positive nutrition claims and may also increase purchases of unhealthy popcorn. The results of this research highlight the importance of understanding how nutrition information impacts consumer behavior. From a manufacturer's and store's perspective, the implications of this research are relevant to a profit maximization strategy. While one would expect positive nutrition claims to lead to increased purchases, we find evidence to the contrary. The implications are also important to an overall store branding strategy. Perhaps not surprisingly, consumers may perceive additional product information unfavorably, which could have undesirable results.

The implications for policy makers are especially relevant given the epidemic of obesity and its related and costly health problems. Our results prompt consideration of important policy questions. Are private nutrition labels effective in terms of public health or are they potentially harmful? Should front of package or shelf labels be required that also have negative information, such as the UK's Traffic Light System? This research provides a modest example of unintended effects generated by a specific type of nutrition label with a specific type of product. Further research across more products with more types of nutrition labels and claims should be investigated.

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Table 1: Nutrition labels provided in each store

	Store				
nutrition label	1	2	3	4	5
low calorie	x			x	x
low fat	x	x	x		x
no trans fat					x
low fat/low calorie	x				x
low calorie/no trans fat					x
low fat/no trans fat					x
low calorie/low fat/no trans fat					x

Table 2: Number of labels used in each store and store characteristics

	Store				
nutrition label	1	2	3	4	5
low calorie	6			17	2
low fat	5	16	13		1
no trans fat	14				14
low fat/low calorie					0
low calorie/no trans fat					4
low fat/no trans fat					1
low calorie/low fat/no trans fat					14
Total labeled	25	16	13	17	36
Total number of products	64	62	26	62	60
% of products labeled	39%	26%	50%	27%	60%
square footage	30,440	27,178	19,348	26,425	30,168

Table 3: Demand estimates for healthy and unhealthy popcorns, no label effect included

	healthy popcorn		**unhealthy popcorn**	
parameter	***estimate***	***p-value***	***estimate***	***p-value***
own price	-380.473	<.0001	-1521.38	<.0001
cross price	25.27	0.09	25.27	0.09
income effect	0.001	0.25	0.013	<.0001
time trend	-0.06	0.22	-0.69	<.0001
summer	-0.55	0.53	-0.31	0.9
fall	0.78	0.42	12.99	<.0001
winter	5.4	<.0001	5.47	0.03
adj R-squared	0.723		0.717	

Table 4: Estimates of elasticities for each store

Store	**healthy**	**unhealthy**	**cross-price**
1	-1.94	-1.42	0.06
2	-1.89	-1.01	0.05
3	-1.56	-0.90	0.04
4	-1.08	-0.65	0.03
5	-0.62	-2.25	0.02

Table 5: Demand estimates for healthy and unhealthy popcorns, label effect included as dummy variable

	healthy popcorn		**unhealthy popcorn**	
parameter	***estimate***	***p-value***	***estimate***	***p-value***
own price	-383.978	<.0001	-1530.51	<.0001
cross price	31.53	0.0365	31.53	0.0365
label effect	-5.58	0.0066	7.53	0.2011
income effect	0.001	0.1742	0.012	<.0001
time trend	-0.06804	0.164	-0.67	<.0001
summer	-0.57	0.5135	-0.27	0.9151
fall	1.31	0.1872	12.29	<.0001
winter	5.4	<.0001	5.48	0.0311
adj R-squared	0.724		0.718	

Table 6: Average popcorn sales during treatment period versus non-treatment period

		Total Average	Healthy		Unhealthy	
		Sales	Sales	Price	Sales	Price
treatment stores	**1**	lower	**lower**	**lower**	lower	higher
	2	lower	**lower**	**lower**	lower	higher
	3	**higher**	higher	lower	**higher**	**higher**
	4	lower	**lower**	**lower**	lower	higher
	5	lower	higher	lower	lower	higher
non-treatment	**6**	lower	higher	lower	lower	higher
	7	lower	**lower**	**lower**	lower	higher
	8	lower	higher	lower	lower	higher
	9	lower	higher	lower	lower	higher
	10	**higher**	higher	lower	**higher**	**lower**

Table 7: Demand estimates for healthy and unhealthy popcorns, post treatment effect included as dummy variable

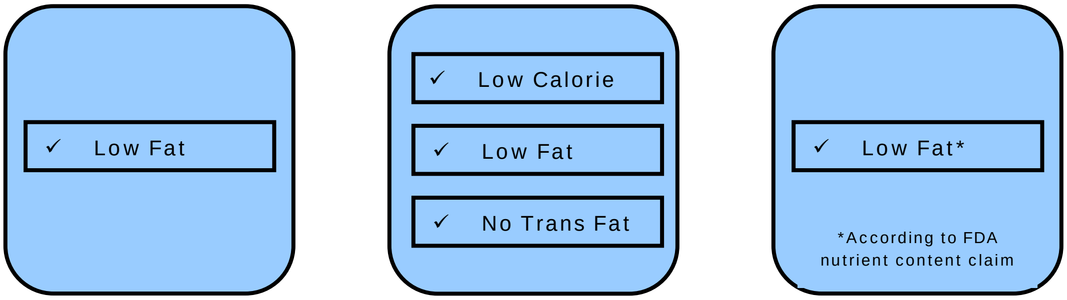
	healthy popcorn		unhealthy popcorn	
parameter	***estimate***	***p-value***	***estimate***	***p-value***
own price	-403.19	<.0001	-1511.82	<.0001
cross price	23.4	0.13	23.4	0.13
label effect	-8.35	<.0001	9.37	0.13
post treatment effect	-5.37	<.0001	4.37	0.23
income effect	0.002	0.06	0.01	0.0002
time trend	-0.06	0.21	-0.66	<.0001
summer	-0.92	0.29	-0.21	0.93
fall	2.4	0.02	11.18	0.0002
winter	6.42	<.0001	4.44	0.09
adj R-squared	0.726		0.717	

Table 8: Welfare effects: Value of nutrition label information

Store	Popcorn	Avg Quantity oz, 2006-2008	Avg Price/oz 2006-2008, (2008 $'s)	Price to prevent change in purchase	COI	confidence interval*
1	Healthy	40.71	$0.207	$0.193	$0.056	-$0.78
	Unhealthy	95.55	$0.089	$0.094		$0.89
2	Healthy	44.75	$0.223	$0.208	$0.056	-$0.78
	Unhealthy	129.01	$0.086	$0.090		$0.89
3	Healthy	51.82	$0.213	$0.198	$0.056	-$0.78
	Unhealthy	152.93	$0.090	$0.094		$0.89
4	Healthy	77.30	$0.220	$0.205	$0.056	-$0.78
	Unhealthy	208.95	$0.089	$0.093		$0.89
5	Healthy	73.13	$0.219	$0.205	$0.056	-$0.78
	Unhealthy	133.69	$0.109	$0.113		$0.89

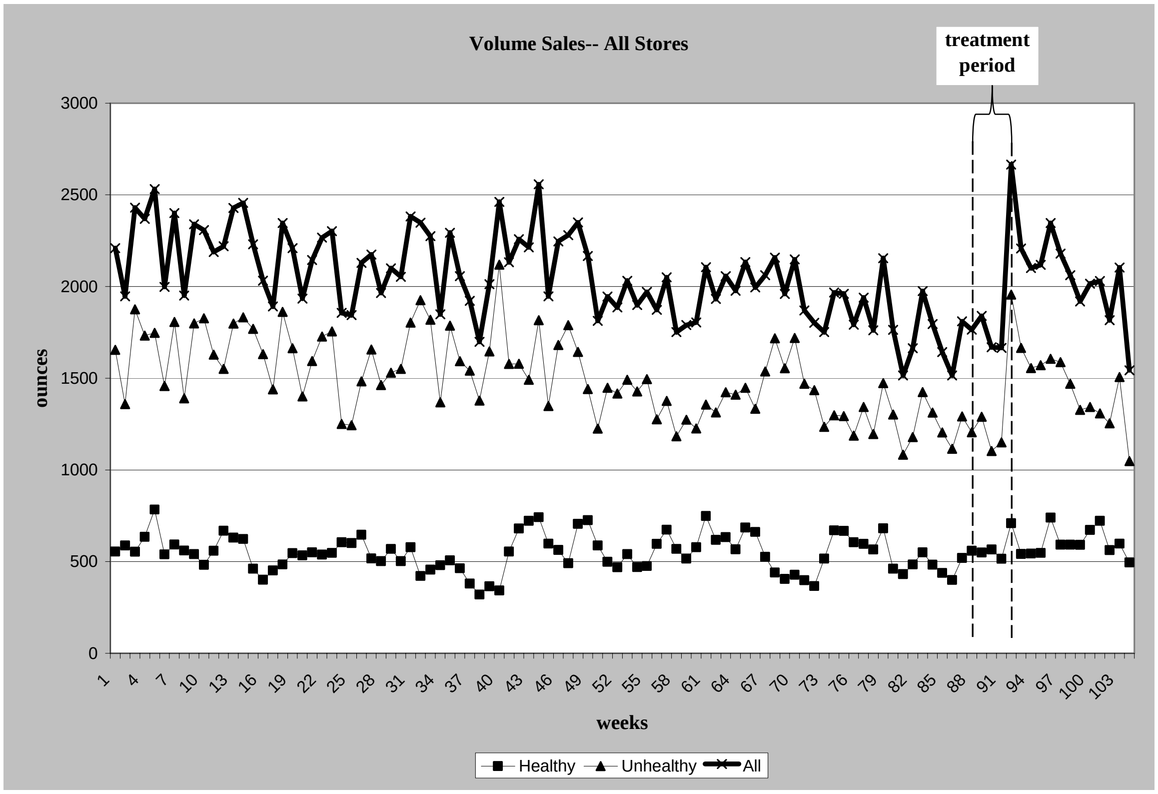
*** calculated at 90 percent assuming a normal distribution**

Figure 1: Nutrition label examples



The first label was provided on products that are Low Fat, the second label on products that were Low Calorie, Low fat and had No Trans Fat. The third label included a statement that the Low Fat claim was based on FDA standards.

Figure 2: Total sales in all stores



[1] It is important to note that claims such as *low fat* must meet FDA standards for such claims whereas proprietary labels offered by manufacturers or grocery stores do not have to meet any regulatory standards as long as they make no health claims backed by the FDA.

[2] While there were seven possible labels for store five, the available products dictated that only six labels be used.

[3] The value is no different from zero calculating the confidence intervals making no distributional assumptions as well.

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Food Marketing Policy Center
1376 Storrs Road, Unit 4021
University of Connecticut
Storrs, CT 06269-4021

Tel: (860) 486-1927
FAX: (860) 486-2461
email: *fmpc@uconn.edu*
http://www.fmpc.uconn.edu