Media Impact of Nutrition Information on Food Choice

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Abstract

This study estimated the impact of nutrition information provided by popular media on consumers' purchases in U.S. grocery stores, taking omega-3 fortified eggs as an example. The media index was constructed from multiple information sources by utilizing computer-coded content analysis. Their probability of purchasing omega-3 eggs between 1998 and 2007 based on household-level scanner data was analyzed by logistic regression models to incorporate elements of information effects. The results showed the significant positive impact of nutritional information from the popular media on consumers' food choices, thus publishing in popular media can be an effective communication approach to promote consumers' health.

Keywords: Consumer Economics, Content Analysis, Functional Food, Information economics, Logit, Omega-3 Fatty Acids

JEL classification: D12, D83

Introduction

Consumers in the United States have become increasingly concerned with chronic and preventable health problems. Diet and nutrition has been identified as one of the biggest factors which directly affect health. Whitney and Rolfes (2010) stated that four out of the top six leading causes of death in the U.S. has a link with diet.[1] Thus, credible nutritional information has become more valuable to individuals.

While much nutritional information has been known for several decades, new information is constantly appearing as a result of continuing research. New nutritional information, and its connection with food, is expected to affect consumers' food choices by reducing uncertainty about the health attributes of those foods. Understanding the impact of nutritional and health information on consumers' food choices will contribute to the development of economic models of consumer demand and to the development and implementation of effective communication approaches for changing dietary behaviors. This will not only help policy makers design regulatory and legal polices that promote health, but will also help food firms develop products that better match consumers' desire for healthy foods.

[1] Six causes are: 1) heart disease, 2) cancers, 3) strokes, 4) chronic lung diseases, 5) accidents, and 6) diabetes mellitus. Heart disease, cancers, strokes, and diabetes mellitus have a link with a diet.

The purpose of this study is to estimate the impact of nutrition information provided by popular media on U.S. consumers' purchases. This study also takes into account other factors contributing to their food choices such as prices, income, household demographics or regional differences. Consumers' knowledge is not observable, so one of the ways to measure the impact of nutrition information is by forming indicators from the content of the articles in the media and by looking at the correlation between that content and changes in food purchases.

Consumers' food purchases are assumed to reflect their knowledge of and desire for those products, both of which have been influenced by exposure to public information about those products. It is nearly impossible for researchers to find a comprehensive metric to representing the total flow of information to consumers; hence it is necessary to make several simplifying assumptions when selecting the proxy for nutrition information (Chang and Just, 2007). Even though new information initially becomes available to the public in scientific journals, they are unlikely to be a direct information source for most consumers. Moreover, consumers tend to get the information through public media rather than from doctors or dietitians (Food Marketing Institute, 2008). Therefore, this study makes an assumption that consumers obtain scientific nutritional knowledge through the popular media.

Since it is impossible to know which particular articles or transcripts consumers respond to, their exposure to the nutritional information is estimated by analyzing the volume and contents of articles and transcripts in the media over time. While their response to food safety events, which is often used as an example in the study of information impact on food choices, are typically temporary so the purchases recover from the shock after a short lag, consumers' response to nutritional information could be slow and cumulative. This study incorporates the effect of time by specifying the lagged media index, which reflects the presumed delayed impact of messages as information is added to the stock of knowledge or beliefs in consumers' minds (Verbeke and Ward, 2001).

Contributions

This study makes two major contributions. First, this study examines the impact that positive, scientific nutritional information has on consumer demand, as it is presented by the mass media. Most of the studies of the impact of information on food demand have been done in the context of foodborne illness or food safety events, especially on meat (Taylor and Phaneuf, 2009; Piggott and Marsh, 2004; Burton and Young, 1996). In terms of nutritional information, most studies have analyzed the

impact of negative nutrition information such as the link between dietary cholesterol and egg consumption (Brown and Schrader, 1990; Chang and Just, 2007). Moreover, while many studies were conducted to analyze the advertising effect (Ippolito and Pappalardo, 2002; Capps and Park, 2002), the impact of scientific nutritional information is rarely analyzed. This study focuses on more objective and reliable information, based on scientific evidence, than information obtained by an advertisement of a particular product.

Second, this study is a more comprehensive examination of the impact of information sources on food purchases. Specifying a "media index" based on a single information source such as newspapers and simply counted the raw number of articles is a common practice in many previous studies (Piggott and Marsh, 2004; Burton and Young, 1996; Liu et al., 1998; Verbeke and Ward, 2001; Ippolito and Pappalardo, 2002; Chang and Just, 2007). Compared to those studies, studies that utilized multiple media types of information sources are relatively rare (Feick, Hermann, and Warland, 1986; Kinsey et al. 2009). This study utilizes multiple media types and employs computer-coded content analysis to identify the type of message and its connection to health. Computer-coded content analysis produces a more detailed indicator of the content and is also good at handling huge amounts of text data, but it remains underused

for demand analysis.[2]

Omega-3 Fatty Acids Enhanced Eggs

While the motivation for this study is a general interest in the nutritional content of foods, eggs enhanced with omega-3 fatty acids are the primary focus of this study. Omega-3 fatty acids are one of the dietary fatty acids. Important examples of omega-3 fatty acids include alpha-linolenic acid (ALA), eicosapentaenoic acid (EPA), and docosahexaenoic acid (DHA).[3] Fatty fish, walnuts, flaxseed, and canola oil are rich in omega-3 fatty acids. In addition to these foods, omega-3 fatty acids are also now available as omega-3 fortified products. Among a variety of food products fortified with omega-3, omega-3 fortified eggs are one of the most popular products (Mintel, 2008).

Omega-3 fatty acids have received growing attention because of their scientifically proven health benefits. The most famous benefit being their ability to help reduce the risk of cardiovascular disease, which was first noticed in epidemiological studies among Greenland Inuits (Bang, Dyerberg, and Sinclair, 1980). Since then, more

[2] The software used for content analysis is called InfoTrend®, developed by Professor David Fan, Department of Genetics and Cell Biology, University of Minnesota.

[3] ALA is the precursor to EPA and DHA.

than 8,000 research publications support omega-3 fatty acids' health benefits.[4] In September 2004, the Food and Drug Administration (FDA) concluded that there was enough scientific evidence to allow companies to make qualified health claims on food labels about two specific omega-3 fatty acids, EPA and DHA.[5]

The omega-3 eggs were produced by adding omega-3 rich food such as flaxseed into hen feed. The omega-3 eggs are rich in omega-3 but taste the same as regular eggs and therefore offer an easy way of increasing omega-3 in the diet, without changing the diet or turning to supplements. Although these eggs usually sell at a premium price compared to the typical eggs, the number of omega-3 eggs purchased has increased.

Literature Review

Research on the impact of information on food consumption has often taken the form of measuring the impact of the food safety events on meat demand. The results have been inconsistent from small impacts (Piggott and Marsh, 2004; Taylor and Phaneuf, 2009) to large impacts (Verbeke and Ward, 2001; Burton and Young, 1996). Turning to the impacts of positive information on food demand, previous studies often

[4] Only calcium has as much scientific evidence for importance in human health.

[5] In 2000, the FDA announced a similar qualified health claim for dietary supplements.

focused on advertising and suggested advertising significantly increased consumers' purchases (Capps and Park, 2002).

Regarding the impact of nutrition information in the media on food demand, the most common studies are those that examine cholesterol information. Several studies found significant negative impact of the information on the links between cholesterol and heart disease on U.S. egg consumption (Brown and Schrader, 1990; Chang and Just, 2007). Kim and Chern (1999) found that increasing consumer health information about cholesterol appears to have reduced the consumption of hog grease, tallow, and palm oil, and increased the use of fish oil, but so far it has had no major impact on the demand for other vegetable oils in Japan.

Several studies have found demographic differences in the demand for omega-3 products. Chase et al. (2007) developed profiles of Canadian omega-3 consumers and found that an aging (baby boomer) population is the most frequent purchaser of omega-3 products, and the presence of children increases the purchasing frequency of omega-3 yogurt and omega-3 margarine. The Mintel report (2008) showed that household income is the strongest factor affecting omega-3 purchase. According to Mintel, age is also an important factor; individuals over age 45 are more likely to buy omega-3 products.

Data

Consumption data and media data are taken from different sources and then combined. Consumption data are from ACNielsen Homescan® consumer panel study.[6] These data are scanned purchase records from more than 7,000 U.S. households who participated in the study from 1998 to 2007. The transcripts and articles from multiple information sources are picked up by keyword searches in LexisNexis® Academic and then put into content analysis software called InfoTrend® to generate scores that represent the intensity of messages about the health benefits of omega-3 fatty acids.[7]

AC Nielsen Homescan® data consist of daily retail food purchases for in-home use as well as the household demographics. Each household is provided a handheld scanner and asked to scan universal product codes (UPCs) of all purchased products after each shopping trip. After the scanning, all households upload the purchase records to ACNielsen. Table 1 shows the descriptive statistics calculated as the average across the ten years. The average household size is 2.45. The average household income

[6] Data were obtained under a memorandum of understanding between The Food Industry Center (TFIC), the University of Minnesota (UMN) with Principle Investigator Professor Jean Kinsey and the United States Department of Agriculture (USDA) Economic Research Service (ERS) in compliance with requirements of AC Nielsen Homescan® consumer panel.

[7] InfoTrend® was developed by Professor David Fan, Department of Genetics and Cell Biology, University of Minnesota.

calculated by taking the middle value of the range (e.g., take $6,500 as a value of $5,000-$7,999) is $55,150.[8] Assuming that the female head is a main decision maker for grocery purchases, female head was taken as a head. If there is no female head in the household, the male head was considered as a head. The average age of head calculated by taking the middle value range (e.g., use 27 years old for 25-29 years old) of the range is slightly over 52.[9]

The number of households who bought eggs in the year by the type of eggs is summarized in Table 2. Omega-3 eggs were distinguished by the UPC code description. Gradually the percentage of households who bought omega-3 eggs increased during this period. Table 3 shows the price of eggs. Prices were subsequently calculated by dividing total expenditure by total quantity for each household's egg purchases. While regular egg prices fluctuate over the period which corresponds with Consumer Price Index (CPI), the omega-3 eggs price has been going up steadily.

LexisNexis® Academic is an online source for researching news topics and has been used in many studies (Taylor and Phaneuf, 2009; Piggott and Marsh, 2004; Burton and Young, 1996). The sample of media stories mentioning omega-3 fatty acids from

[8] $150,000 was used as a value for $100,000 & over.

[9] 22 years old was used as an age for under 25 years and 70 years old was used as an age for 65+ years.

1998 to 2007 was obtained from 76 information sources including newspapers (40), newswires (6), TV (6), radio (1), and magazines (23). This selection of the sources was based on the popularity (circulation) and availability during the period.

Once retrieved, the texts are analyzed by computer using InfoTrend® software for computer analysis to score each story for the number of paragraphs referring to the health benefits of omega-3 fatty acids. This software generates scores according to the list of words and /or phrases and a set of computer rules that are designated by iterative refinement. The computer instructions are developed for several random samples of news text and are then applied to whole stories.

The scores were categorized into three media types; that is, a) newspapers and newswires, b) TV and radio, and c) magazines. Scores were summed up for each type on monthly basis. Then, following Kinsey et al. (2009), a media index is constructed by normalizing and weighting the scores across media types. Scores for each media types are normalized as $Z_{kt} = \frac{x_{kt} - Min(x_k)}{Max(x_k) - Min(x_k)} \times 100$, where Z_{kt} is the standardized score for media source k during month t, x_{kt} is the score for media source k (k=1: newspapers & newswires, k=2: TV & radio, and k=3: magazines) during month t, and Min(x_k) and Max(x_k) are the minimum and maximum scores for the kth media source over the sample period.

After this normalization, the index involves aggregating standardized scores (Z_{kt}) using the following formula $S_t = \sum_{k=1}^{3} w_k Z_{kt}$ Where S_t is the media index value for month t and w_k is the weight assigned to the kth media source where $\sum_{k=1}^{3} w_k = 1$ and $0 \le w_k \le 1$. The weights for each media source aims to capture the difference in "reach" of media; i.e. some media sources reach a larger audience than other sources. According to a survey on consumers' nutrition information sources in 2005 conducted by the Food Marketing Institute (2008), 34% of the survey participants say that they use newspapers as a nutritional information source, and 38% use television, 12% use radio, and 46% use magazines. In this study, TV and radio were integrated since national public radio is the only available source for radio. The response for TV was taken as a response for TV and radio. Hence, the weights became $w_{1(\text{newspapers})} = \frac{34}{34+38+46} = 0.29$, $w_{2(\text{TV and radio})} = \frac{38}{34+38+46} = 0.32$, and $w_{3(\text{magazines})} = \frac{46}{34+38+46} = 0.39$.

The effect of mass media coverage is expected to be cumulative extending back several months (Verbeke and Ward, 2001). In order to capture this, a five-period distributed lag was specified to extend the total response interval to a period of six months. Six months lag is consistent with recommendations by Clarke (1976) and with the approaches followed by Brown and Schrader (1990) or Liu et al. (1998).

After the media index for the month (S_t) is generated, the discounted media

index T_t is calculated by assuming a monthly decay rate of twenty percent in distributed lag scheme, following Kim and Chern (1999). Therefore, $T_t = S_t + 0.8S_{t-1} + (0.8)^2S_{t-2} + (0.8)^3S_{t-3} + (0.8)^4S_{t-4} + (0.8)^5S_{t-5}$.

Models

In this study, households' monthly purchase of various types of eggs is treated as a discrete variable. Discrete choice models have been commonly used for demand analysis of functional foods including special eggs (Goddard et al., 2007; Chase et al. 2007). The underlying structural model of behavior is a random utility maximization model. Consumers are assumed to choose the alternative from which they derive the highest utility. The utilities are determined by the household characteristics and the alternatives available. The probability depends on the assumptions on the distribution of the stochastic error terms.

In this study, households' monthly purchase of eggs is categorized into either a) purchase of regular eggs only or b) purchase including omega-3 eggs (either purchase of omega-3 eggs only or purchase of both regular eggs and omega-3 eggs in the month). The households who did not buy any eggs in the month were excluded from this study. Since there are repeated observations over time on households, standard errors were

adjusted by clustering by households. The standard errors allow for intragroup correlation, relaxing the usual requirement that the observations be independent. The empirical model used is the logistic regression model (logit) model. The marginal effects are calculated at the means of the independent variables.

Results

Table 4 shows the result from logistic regression. The main variable of interest, the discounted media index (MI) has a significantly positive effect on consumers purchase choice. It implies that consumers obtain new scientific nutritional knowledge through the popular media and consumers' purchase choice reflects their knowledge on the new nutritional information and its connection with food.

Demographic and regional difference of the households also had impacts on consumers' food choices. Household income, age of household head, education of household had positive relationships with their omega-3 eggs purchase probability. Household size had a negative relationship with omega-3 eggs purchase. If the households are living in urban area, the probability of buying omega-3 eggs increases. Compared to the people in the southern region, people in the east are more and people in central or west are less likely to buy omega-3 eggs.

One of the interesting findings is the consumers' behavior toward the price of eggs. Consumers were quite sensitive to the prices of regular eggs. If the price of regular eggs decreases, the price difference between regular eggs and omega-3 eggs widens and discourages consumers to choose omega-3 eggs. In fact, whether the regular eggs are on sale or not caused the largest marginal change of all the variables in the model. On the other hand, consumers were not very sensitive to a change in the price of omega-3 eggs. Their characteristics that promise to improve consumers' health seem to have a stronger impact than their prices on purchase choice of omega-3 eggs.

Conclusion

This study estimated the impact of nutrition information – health benefits of omega-3 fatty acids – provided by popular media as well as the impact of other factors such as household demographics on U.S. consumers' purchases of omega-3 eggs. Their probability of purchasing omega-3 eggs was analyzed by using logistic regression.

The impact of nutritional information from the popular media on consumers' food choices is substantial. Although omega-3 fortified eggs usually sell at a premium price compared to the typical eggs, growing knowledge of the health benefits of omega-3 propels their consumption. Since people are more aware of their health

problem, they further appreciate these kinds of characteristics. To change dietary behaviors in order to promote health, publishing in popular media can be said to be an effective communication approach.

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Table 1 Household Panel Demographic Variables (Average of 1998-2007)

Demographic Variable	Frequency	%	Demographic Variable	Frequency	%
			Age of Head		
Number of Households	21503		Under 25 Years	94	0.44
			25-29 Years	542	2.52
Household Size			30-34 Years	1223	5.69
Single Member	5171	24.05	35-39 Years	1819	8.46
Two Members	8648	40.22	40-44 Years	2479	11.53
Three Members	3222	14.98	45-49 Years	2925	13.60
Four Members	2753	12.80	50-54 Years	2969	13.81
Five Members	1126	5.24	55-64 Years	4953	23.03
Six Members	384	1.79	65+ Years	4500	20.93
Seven Members	125	0.58			
Eight Members	46	0.22	**Education of Head**		
Nine+ Members	28	0.13	Grade School	111	0.51
			Some High School	629	2.92
Household Income			Graduated High School	5628	26.17
Under $5000	156	0.73	Some College	6962	32.38
$5000-$7999	234	1.09	Graduated College	5868	27.29
$8000-$9999	215	1.00	Post College Grad	2305	10.72
$10,000-$11,999	325	1.51			
$12,000-$14,999	590	2.74	**Race**		
$15,000-$19,999	1062	4.94	White	17816	82.85
$20,000-$24,999	1518	7.06	Black	2132	9.91
$25,000-$29,999	1429	6.64	Oriental	474	2.20
$30,000-$34,999	1625	7.56	Other	1081	5.03
$35,000-$39,999	1449	6.74			
$40,000-$44,999	1488	6.92	**Hispanic**		
$45,000-$49,999	1400	6.51	Yes	1349	6.28
$50,000-$59,999	2359	10.97	No	20154	93.72
$60,000-$69,999	1967	9.15			
$70,000-$99,999	3467	16.12	**Region**		
$100,000 & Over	2218	10.32	East	3701	17.21
			Central	5218	24.27
Presence of Children			South	8097	37.65
Yes	5633	26.19	West	4487	20.87
No Children Under 18	15870	73.81			
			Major Market		
			Yes	8703	40.47
			No	12800	59.53

Table 2 Number of Households who bought eggs in the year by the types of eggs

	Any eggs	Regular eggs only	(%)	Omega-3 eggs only	(%)	Both kind of eggs	(%)
1998	7304	6819	93.4	20	0.3	465	6.4
1999	6826	6347	93.0	23	0.3	456	6.7
2000	7182	6700	93.3	27	0.4	455	6.3
2001	7769	7254	93.4	37	0.5	478	6.2
2002	8197	7608	92.8	51	0.6	538	6.6
2003	8337	7587	91.0	53	0.6	697	8.4
2004	37592	33310	88.6	291	0.8	3991	10.6
2005	36839	32712	88.8	331	0.9	3796	10.3
2006	35600	31206	87.7	357	1.0	4037	11.3
2007	59384	50460	85.0	715	1.2	8209	13.8

Table 3 Annual average price and Consumer Price Index for Eggs

	Regular Eggs (per dozen)	Omega-3 Eggs (per dozen)	CPI for Eggs (1982-84=100)
1998	1.06	1.82	135.48
1999	0.97	1.85	128.22
2000	1.00	1.96	131.93
2001	1.04	2.05	136.48
2002	1.03	2.12	138.28
2003	1.22	2.21	157.36
2004	1.25	2.30	166.88
2005	1.02	2.33	144.21
2006	1.09	2.36	151.16
2007	1.51	2.41	195.47

Souces: BLS (for CPI)

Table 4 Estimates from Logit with Discounted Media Index for Omega-3 Health Benefits

	Coefficient	Standard Error	Marginal Effect	Standard Error
Household Size	-0.14764	0.01353 ***	-0.00508	0.00046 ***
Household Income	0.00622	0.00035 ***	0.00021	0.00001 ***
Household Age	0.01100	0.00137 ***	0.00038	0.00005 ***
Household Education (D)	0.17735	0.03083 ***	0.00625	0.00111 ***
Major Market (D)	0.12502	0.03073 ***	0.00426	0.00104 ***
East (D)	0.24259	0.03851 ***	0.00901	0.00154 ***
Central (D)	-0.51861	0.04269 ***	-0.01592	0.00116 ***
West (D)	-0.18862	0.04262 ***	-0.00616	0.00132 ***
Spring (D)	0.01953	0.01853	0.00067	0.00064
Fall (D)	0.12656	0.00994 ***	0.00448	0.00036 ***
Winter (D)	0.01531	0.01551	0.00053	0.00054
Regular Egg Price	0.21295	0.01790 ***	0.00732	0.00062 ***
Omega Egg Price	-0.06330	0.18694	-0.00218	0.00643
Regular Egg Deal (D)	-1.37588	0.02703 ***	-0.03705	0.00076 ***
Discounted MI for Health	0.00593	0.00053 ***	0.00020	0.00002 ***
Constant	-4.32704	0.38449 ***		

The number of observations is 1,541,638.
(D) indicates dummy variable. Their marginal effects are for discrete change from 0 to 1.
***: significant at 1% level.
The standard errors are adjusted for 84,420 clusters in households.