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Consumer Characteristics Associated with Low Fat, Low Cholesterol Foods

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ABSTRACT: This study identifies several characteristics and factors of individuals who are more likely to try low-fat, low-cholesterol foods. The analysis was performed using logit analysis. The results imply that the following individuals are more likely to try low-fat, low-cholesterol foods: those with high incomes, whites compared to blacks, females, those with smaller households, those with high body mass index, those who have a better perception of their own health, those who are aware of the link between diet and disease, nonsmokers, and those who do not agree that people are born fat or thin and that there is nothing one can do about it.

INTRODUCTION

Scientific evidence increasingly suggests the importance of diet in the onset of chronic diseases. For example, diets high in fat and cholesterol have been found to be associated with increased incidence of coronary heart disease, certain types of cancer, and stroke. Research has also shown that these diseases could be prevented through dietary changes. Consequently, due to increasing evidence linking diet and health, consumers are now more aware of the importance of healthful diets. In fact, the overall level of concern about nutrition and more specifically, about fat and cholesterol content of foods has increased significantly (Chanil, 1994). Also, 92% of food shoppers interviewed for the 1995 annual survey by the Food Market-

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ing Institute reported having changed their diets to more healthful ones (Frazao, 1996).

Consequently, sales of nutritionally improved foods such as low fat and low cholesterol food products have significantly increased in the last decade. Supermarket sales of nutritionally improved foods grew faster than sales of their regular counterparts between 1989 and 1993, despite their usually higher prices. In 1993, nutritionally improved foods represented 39% of sales volume in supermarkets, up from 36% in 1989 (Frazao and Allshouse, 1995). Moreover, an increasing proportion of new food products carry at least one nutrient content claim, most often claims about reduced fat or cholesterol content. In 1995, there were at least 1,500 claims about improved fat or cholesterol content in new food products, over five times more than in all of 1988 (Frazao, 1996; Thayer 1997). Consumers' concern about nutrition and health is now considered one of the issues that dominate conversations about new food product introductions. Consequently, most experts predict a greater move toward low-fat, low-cholesterol items in the next few years (Liebeck, 1997).

These trends point to a growing appetite by Americans for eating healthy foods such as low-fat and low-cholesterol products. Although the food industry has been actively responding to consumer demand by developing new foods with improved nutritional profiles, the failure rate of these new food products remains high (Rose 1995). The food industry has been criticized in this regard for not knowing their customers (Thayer, 1997). To fill this void, this article examines the consumer characteristics associated with the consumption of low-fat, low-cholesterol foods. Knowledge of these characteristics and factors can be used as a guide in developing marketing programs for products claiming low-fat or low-cholesterol contents. With the exception of the work by Nayga (1994), no other known study has been done on this topic. In addition, Nayga's study utilized the 1987-88 Nationwide Food Consumption Survey and, therefore, may no longer represent current market conditions. The present study examines not only consumers' demographic factors but also health/nutrition related factors using the 1994 Diet and Health Knowledge Survey from the U.S. Department of Agriculture.

Empirical Model

A model is estimated to examine the likelihood that an individual is on a low-fat, low-cholesterol diet. The logit framework is used for this purpose. The logit technique is preferred over other categorical variable estimation technique (Maddala, 1983) and is a better procedure for capturing the magnitude of the independent variable effects for qualitative dependent variables than are probit models (Amemiya, 1983). The logit model is estimated using maximum likelihood estimation as it results in large-sample properties of consistency and asymptotic normal-

ity of the parameter estimates. The model is based on the cumulative logistic probability function and is specified as (Pindyck and Rubinfeld, 1991):

$$P = F(Z) = F(X_i'\beta) = 1/(1+e^{-Z}) = 1/(1+e^{-(Xi'\beta)})$$

where Z is a theoretical index determined by a set of explanatory variables X; F(Z) is the cumulative logistic function; e represents the base of natural logarithms (approximately equal to 2.718); and P is the probability that an individual will make a certain choice, given the knowledge of X.

The logit model centers on the hypothesis that a set of variables influence the decision to be on a low-fat, low-cholesterol diet. The logit model is specified as follows:

$$Prob=b_0 + b_1 income + b_2 incomesq + b_3 black + b_4 other + b_5 age + b_6 agesq + b_7 male + b_8 employed + b_9 hsize + b_{10} educ + b_{11} bmi + b_{12} phealth + b_{13} thinfat + b_{14} dietdis + b_{15} smoke + b_{16} exercise + b_{17} tvhours + b_{18} price + b_{19} taste;$$

Table 1. Description and Means of the Independent Variables Used in the Analysis

Name	*Description*	*Mean*
income	household income ($ in thousand)	33.54
incomesq	square of income	
black	1 if respondent is black; 0 otherwise	0.13
other	1 if respondent is of some other race; 0 otherwise	0.05
age	age of the respondent in years	48.62
agesq	square of age	
male	1 if respondent is male; 0 otherwise	0.48
employed	1 if respondent is employed; 0 otherwise	0.40
hsize	household size	2.66
educ	respondent's highest level of education in years	12.64
bmi	body mass index	26.33
phealth[a]	individual's perception of his or her health	2.53
thinfat[b]	degree of agreement on the statement "some people are born to be fat and some thin; there is not much you can do to change this"	2.32
dietdis[b]	degree of agreement on the statement "what you eat can make a big difference in your chance of getting a disease, like heart disease or cancer"	3.47
smoke	1 if individual smokes, 0 otherwise	0.25
exercise[c]	amount of exercise	3.84
tvhours	number of TV hours watched yesterday	2.53
price[d]	perceived importance of price when food shopping	3.29
taste[d]	perceived importance of taste when food shopping	3.80

Notes: base group of individuals consists of those who satisfy the following description: white, female, unemployed, and those who do not smoke.

a. Responses range from 1 to 5 where 1 = "excellent" and 5 = "poor".

b. Responses range from 1 to 4 where 1 = "strongly disagree" and 4 = "strongly agree".

c. Responses range from 1 to 6 where 1 = "daily" and 6 = "rarely or never".

d. Responses range from 1 to 4 where 1 = "not at all important" and 4 = "very important".

where Prob is a binary variable equal to1 if individual is on a low-fat, low-cholesterol diet and 0 otherwise. The description and the means of the independent variables are exhibited in Table 1. These variables include income, race, age, gender, employment status, household size, education, body mass index, health perception, smoking, exercise, television hours, importance of price, importance of taste, diet-disease awareness, and an attitudinal health variable.

For estimation purposes, one classification was eliminated from each group of dummy variables. The base group of individuals consists of those who satisfy the following description: white, female, unemployed, and those who do not smoke.

The variables "phealth," "thinfat," and "dietdis" were measured using the scales described in the footnote of Table 1. The "phealth" variable is hypothesized to either have a negative or positive sign in the model depending on whether the individual's perception of his or her health status is translated into actual dietary behavior. On the other hand, the attitudinal variable "thinfat" is expected to have a negative sign in the model indicating that the more an individual agrees with the statement "some people are born to be fat and some thin; there is not much you can do to change this," the less likely the individual will be on a low-fat, low-cholesterol diet. The diet-disease awareness variable "dietdis" is expected to be positively related to the likelihood of being on a low-fat, low-cholesterol diet.

Health professionals advise that not smoking and being more active is an important component of a healthy lifestyle. Rose (1995) also revealed that active individuals were less likely to be overweight than were others. Hence, the "exercise" variable is expected to have a negative sign (due to the inverted scale of the variable) and the "smoke" and "tvhours" variables are expected to have a negative sign in the models.

The perceived importance of price and taste variables are included in the model to test the hypothesis that price and taste negatively affect the likelihood of being on a low-fat, low-cholesterol diet. Thayer (1997) and Rose (1995) both alluded to the importance of these factors in consumers' food purchase decisions. They also suggested that the generally higher price of low-fat, low-cholesterol foods as well as the overriding desire of consumers for taste can negate consumers' desire to have a healthy diet.

Racial differences are included as independent variables because of possible differences in media exposure or habits (Putler and Frazao, 1994). For instance, blacks and other non-white races have lower newspaper and magazine readership rates than do whites (U.S. Department of Health and Human Services, 1988). It is, therefore, possible that blacks and other nonwhite individuals are less aware of the benefits of low fat/cholesterol diets to their health than do whites.

Previous studies indicate that men are typically less interested in diet and health issues than are women (Food Marketing Institute, 1990; Nayga, 1997). Consequently, men are probably less likely to be on a low fat/cholesterol diet than do women. The anthropomorphic measurements of the individual—age and body

mass index—are included as exogenous variables to account for physical differences between individuals. The square of income and age are also included to test the nonlinearity of the relationship of these factors on the probability of being on a low-fat, low-cholesterol diet.

Data Description

The data set used in this study is the 1994 Diet and Health Knowledge Survey (DHKS) from the U.S. Department of Agriculture. The target individuals in this survey were randomly selected from among eligible 1994 Continuing Survey of Food Intakes by Individuals (CSFII) sample persons 20 years of age and older who had provided a complete Day 1 intake record. Data in this survey were collected by computer assisted telephone interviews (in-person interviews for those without telephones). A total of 1,879 individuals participated in the DHKS survey. Due to incomplete data in some of the variables, 1,530 observations were used in the analysis discussed in this paper.

The survey contains various sociodemographic and economic variables. Sample statistics for the variables used in the models are presented in Table 1. About 13 % of the sample are black, five percent are of other non-white race, 48% are males, 40% are employed, and about 25% are smokers. Average household income is

Table 2. Maximum Likelihood Estimates of the Model

Variable	*Parameter*	*Standard Error*	*Change in Probability*[a]
intercept	-5.1303*	1.5422	-0.3649
income	0.0244*	0.0130	0.0017
incomesq	-0.0001	0.0001	-0.00001
black	-0.7891*	0.3538	-0.0561
other	-0.1986	0.4579	-0.0143
age	0.0974*	0.0373	0.0069
agesq	-0.0008*	0.0003	-0.00006
male	-0.3954*	0.1859	-0.0281
employed	-0.0468	0.2273	-0.0033
hsize	-0.1981*	0.0817	-0.0141
educ	-0.0018	0.0360	-0.0001
bmi	0.0314*	0.0165	0.0022
phealth	-0.2766*	0.0943	-0.0197
thinfat	-0.1994*	0.0927	-0.0142
dietdis	0.3321*	0.1430	0.0237
smoke	-0.5731*	0.2482	-0.0408
exercise	-0.0750	0.0472	-0.0053
tvhours	0.0566	0.0364	0.0040
price	0.0436	0.1198	0.0031
taste	-0.0789	0.1924	-0.0056
McFadden R^2	0.083		
% Correct Predictions	90.1		

Notes: a. Equal to the product of the parameter estimates times the value of the logistic density function [$\beta^*\lambda(z)$]. At the sample means, the value of this density function [(z)] is 0.071.
*denotes statistical significance at the 0.05 level.

roughly $33, 500, average age is 48 years while the average household size is 2.66. This sample is probably under-representative of employed individuals. The average age of individuals in the sample is also above the national average. Yet, the distribution of individuals by race, gender, and income seems representative of the U.S. population.

Empirical Results

The maximum likelihood estimates of the model are exhibited in Table 2. Regional and urbanization variables were not included in the model due to statistical insignificance. The McFadden R^2 (goodness of fit measure) shown in Table 2 is 0.083. This value is reasonable considering the type of data (survey of individuals) used in the analysis. Based upon the statistically significant coefficients, the results indicate that income is positively related to the likelihood of being on a low-fat, low-cholesterol diet. This result suggests that higher income individuals are more likely to try low-fat, low-cholesterol foods than are lower income individuals. Blacks are less likely to be on a low-fat, low-cholesterol diet than do whites. This finding is consistent with prior expectations as discussed above.

Age is positively related to the likelihood of being on a low-fat, low-cholesterol diet. However, the agesq variable is also significant but negative. This result suggests that the likelihood of being on a low-fat, low-cholesterol diet will increase with age before declining after a certain age level. Therefore, the relationship of age on the likelihood of being on a low-fat, low-cholesterol diet is nonlinear.

Consistent with prior expectations, males are less likely to be on a low-fat, low-cholesterol diet than are females. This result might be related to the findings of Nayga (1997) which suggested that men are less likely to perceive nutrition as important when food shopping than do women. Nayga and Capps (1994) also found that males have a higher cholesterol intake from food eaten at home than do females. These results support the hypothesis that men are typically less interested in diet and health issues than are women.

Household size is negatively related to the likelihood of being on a low-fat, low-cholesterol diet. This empirical result suggests that individuals on larger households are less likely to be on a low-fat, low-cholesterol diet than individuals on smaller households. The reason for this result is not clear. However, household size may measure the problems involved in preparing menus that are acceptable to a large number of persons in a household (Nayga, 1994).

Contrary to prior expectations, education does not affect the likelihood of being on a low-fat, low-cholesterol diet. However, as expected, the diet-disease awareness variable "dietdis" is significantly positive in the model. This result implies that the more an individual agrees that what one eats can make a big difference in the chance of getting a disease like heart disease or cancer, the more likely the individual will be on a low-fat, low-cholesterol diet. This finding is consistent with the findings of another related study which found that diet-disease knowledge contrib-

utes to a healthier diet (Adelaja, Nayga, and Wall, 1997). These findings suggest that the most effective method of nutritional education or marketing tool may be to highlight the disease element of poor nutrition. Some food marketers have already capitalized on this issue. For example, Kellogg's cereal television campaigns have linked its products to the possible prevention of cancer by incorporating the National Cancer Institute's recommendations for a low-fat diet (Meyers, 1985). The commercials represent a dramatic departure from traditional cereal advertising and has strong appeal to growing number of inner directed, health conscious individuals. Consumer response has reportedly been positive and product sales appear to be growing.

Body mass index is also significant and positive in the model which suggests that the higher an individual's body mass index, the higher the probability that the individual will be on a low-fat, low-cholesterol diet. Nayga (1994), using the 1987-88 Nationwide Food Consumption Survey, also found that weight is positively related to the likelihood of being on a low-cholesterol diet. These results might suggest that more people are becoming aware of the link between body mass and health (Rose, 1994). Experts generally agree that excessive body mass is associated with increased risk for developing hypertension, heart disease, and some cancers.

As expected, results indicate that the better an individual's perception is of one's health, the more likely the individual is on a low-fat, low-cholesterol diet. Moreover, the less an individual agrees on the statement "some people are born to be fat and some thin; there is not much you can do to change this," the more likely the individual is on a low-fat, low-cholesterol diet. Consistent with prior expectations as well, smokers are less likely to be on a low-fat, low-cholesterol diet than do non-smokers.

Interestingly, the perceived importance of price and taste variables are not statistically significant in the models. This finding is surprising considering the amount of publicity regarding the higher prices of nutritionally improved foods like reduced fat and cholesterol products as well as the presumed importance of taste in consumer food purchase decisions (Chanil, 1994; Thayer, 1995). Perhaps, food processors and manufacturers have now developed better tasting and more price competitive low-fat, low-cholesterol food products to compete with the regular products.

SUMMARY AND IMPLICATIONS OF THE STUDY

To keep up with the recent trends in consumer demand for low-fat, low-cholesterol food products, an understanding of the associated consumer characteristics is needed. Due to the increasing concerns about nutrition and health, the food/agribusiness industry is continually interested in creating a vast array of concepts that appeal to specific consumer tastes and preferences. It is, therefore, imperative that

the profile of individuals who are more likely to try low-fat, low-cholesterol foods be known to the food industry. This information is particularly useful for processors and producers who want to anticipate future market changes and derived demands for their products.

The results imply that the following individuals are more likely to try low-fat, low-cholesterol foods: those with high incomes, whites compared to blacks, females, those with smaller households, those with high body mass index, those who have a better perception of their own health, those who are aware of the link between diet and disease, nonsmokers, and those who do not agree that people are inherently born fat or thin and that there is nothing one can do about it.

The identification of consumers likely to eat low-fat, low-cholesterol foods is essential in analyzing consumption behavior and developing specific marketing programs. Food processors and manufacturers selling low-fat, low-cholesterol products should tailor their products to the tastes of these individuals who are most likely to buy their products to boost sales. For example, based on the empirical findings, low-fat, low-cholesterol foods may be targeted to white females with high incomes. Conversely, black males with low incomes may be less receptive to marketing campaigns that promote low-fat or low-cholesterol foods. The result related to diet- disease awareness variable may suggest that an effective marketing tool may be to highlight the disease element of poor nutrition. Hence, food marketers may have to capitalize on this issue in their advertising and promotion campaigns. The Nutritional Labeling and Education Act has standardized health claims and has improved consumers' perceptions about the reliability of labels or claims in food packages (Nayga, 1998). Hence, food marketers now have this regulated marketing tool that they can use to highlight the disease prevention element of their products. An example is Kellogg's cereal television campaigns that have linked its products to the possible prevention of cancer by incorporating the National Cancer Institute's recommendations for a low-fat diet (Meyers, 1985). Restaurants and fast food chains wanting to attract health conscious customers may also enlarge their menus to include salad bars and lighter dishes.

Considering the fact that consumer preferences in most of the civilized world are moving in parallel directions, the findings in this study might be of interest to market analysts not only in the US but elsewhere as well. These results may also have some important implications for government education and public nutrition programs. According to the U.S. Surgeon General's Report on Nutrition and Health, half of the ten leading causes of death are linked to diet (Harris, 1994). The findings in this study could be used as a guide in directing government education programs dealing with the intake of fats and cholesterol toward certain population groups.

A natural extension of this work is the analysis of disaggregate (i.e., brand level) lowfat and low cholesterol food products using scanner data from supermarkets. With the use of club cards, scanner data information can now be linked with cus-

tomer demographics. These data can provide definitive and valuable information in the formulation of market segmentation and targeting strategies (Nayga, 1992; Capps and Nayga, 1991).

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