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Self Efficacy as a Mediator of the Relationship between Dietary Knowledge and Behavior

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Abstract

Translating the dietary knowledge among individuals into healthy behavior remains a challenging task. This study examines the causal relationship between dietary knowledge and behavior by including self-efficacy in the models.

A series of regression models were developed based on Baron and Kenny (1986) to assess whether self-efficacy mediated the link between the predictor variables and dietary behavior. Regression analyses supported the hypothesized relationships that self-efficacy mediates effects of dietary knowledge and social influences on dietary behavior. Self-efficacy also accounted for variance in eating behavior not explained by knowledge or demographic variables.

Keywords: dietary knowledge, dietary behavior, self-efficacy

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Introduction and Objectives

Increased availability of nutritional information has been successful in enhancing public awareness of the importance of healthy diet and lifestyles. The important issue is whether enhanced nutrition and health awareness has any significant impact on consumers' actual dietary behavior. The data from the healthy eating index (HEI) show that although dietary quality has improved over the past years, the diets of most Americans need improvements in several aspects (Kennedy et al. 1999; Guo et al. 2004). Previous studies have examined the influence of health behavior through informational campaigns, followed by the expected change in the attitude and desired behavioral changes in areas like smoking, obesity, and HIV/AIDS (Perry et al. 1980; Stern et al. 1982; Nwokocha and Nwakoby 2002.) While the above studies have reported mixed results of success, studies evaluating the relationship between nutrition knowledge and dietary behavior have found no direct correlation between the two (Putler and Frazao 1994; Sapp 1991).

Clearly, the evidence from the above studies suggests that the impact of additional information and knowledge on actual consumer behavior is an empirical issue. This is in contrast to the premises of the rational choice theory which is the basis for traditional neoclassical theory of demand and consumer choice (e.g., Mas-Colell, Whinston and Green 1995). The implausibility of the rational choice axioms has been documented by many economists including, among others, the Nobel Prize Laureate Kahneman (1994), or more recently Miljkovic (2005). Therefore, translating the dietary knowledge among individuals into healthy behavior remains a challenging task for economic modelers, and in turn the food and health policy makers. Relying on behavioral sciences theories such as the social cognitive theory (SCT), the objective of this study is to examine the causal relationship between dietary knowledge and behavior by including self-efficacy in the models.

Self-efficacy is defined as a person's ability of exerting self-control in changing his/her behavior. Hence, the objective of this study may be more specifically stated as to empirically address the question of whether the predictor variables such as dietary knowledge affect only self-efficacy, or dietary behavior, or both. The self-efficacy component of the SCT has been widely used by many researchers to explain human behavior with regard to, for example, phobias (Bandura 1983) , smoking (Schinke et al. 1985), drug use (Hays and Ellickson 1990), addiction (Marlatt Baer, and Quigley) and food choices (Parcel et al. 1995; Steptoe, et al. 1995). Researchers have suggested that self-belief that includes self-efficacy plays a mediating role in relation to cognitive activities. Bandura (1997) explained self-efficacy belief as "beliefs in one's capability to organize and execute the courses of action required to manage prospective situation." A large amount of previous research has generally supported the basic notion proposed by Bandura (1986 and 1997) that efficacy beliefs mediate the effects of skills on performance by influencing effort, persistence and perseverance (Schunk 1991; Bouffard-Bouchard 1990; and Schunk and Hanson 1985). Corwin et al. (1999) reported that many components from SCT including self-efficacy had significant correlation with the diet related behavior of children. In a study among fourth graders, she reported that the mean dietary exposures scores for low-fat food selection was significantly higher for those children who had scored highest levels of confidence about lower fat food choices than those with lower levels of confidence.

Another study designed to examine the social-cognitive determinants of health behaviors including physical exercise, smoking, alcohol consumption, and preventive nutrition (Schwarzer and Renner 2000) distinguished between action self-efficacy (preintention) and coping self-efficacy (postintention) as two phases of optimistic self- beliefs. The study reported that the importance of perceived self-efficacy increased with the age of the respondent and their body weight.

A person's health related self efficacy is influenced by his/her health knowledge and other socio-demographic background information. Since self-efficacy itself is explained by the dietary knowledge of individuals (Slater 1989), it is likely to play a mediating role in the relationship between healthy behaviors and dietary knowledge. Consumers with higher levels of self-efficacy are more likely to sustain a healthy behavior with regard to food choices compared to those with lowers level of self-efficacy.

Theoretical and Empirical Models

The preceding discussion points to a causal flow from dietary knowledge (hereafter, we call these predictor variables) and socio-demographic characteristics to self-efficacy and/or dietary behavior. At this point, an empirical question that remains to be determined is whether the predictor variables affect only self-efficacy, or dietary behavior, or both. We propose a mediation model here. More specifically, we hypothesize that (a) the predictor and socio-demographic variables influence both self-efficacy and dietary behavior, and (b) these variables influence dietary behavior primarily via their link to dietary knowledge. For example, when consumers possess a high level of dietary knowledge, they are predisposed to exert a greater control over their diets and lifestyle, thereby adopting a healthy dietary behavior.

The hypotheses above underscore the notion of mediation. In other words, the mediation approach recognizes that consumers' self-control (efficacy) over diet and lifestyle can mediate the effects of the predictor variables (dietary knowledge) on the dietary behavior (Baron and Kenny 1986). Figure 1 (as adapted from Baron and Kenny 1986) illustrates this modeling approach using self-efficacy as mediators of the relationship between dietary behavior and predictor variables. The figure depicts three causal paths in a model of how overall dietary behavior is formed: (i) the direct impact of the predictors on dietary behavior (path a); (ii) the path from the predictors to the mediators (path b); and (ii) the impact of mediators on dietary behavior (path c).

In this study, the mediating hypothesis is tested using the following four criteria adopted from Judd and Kenny (1981) and Baron and Kenny (1986): a) the self-efficacy of individuals (mediator) has a statistically significant impact on dietary behavior; b) dietary knowledge and socio-demographic variables (predictors) have significant influence on dietary behaviors; c) dietary knowledge exerts a significant influence on diet related self-efficacy of individuals; and d) the effects of dietary knowledge is either diminished or no longer significant when self-efficacy is controlled for the dietary behavior equations.

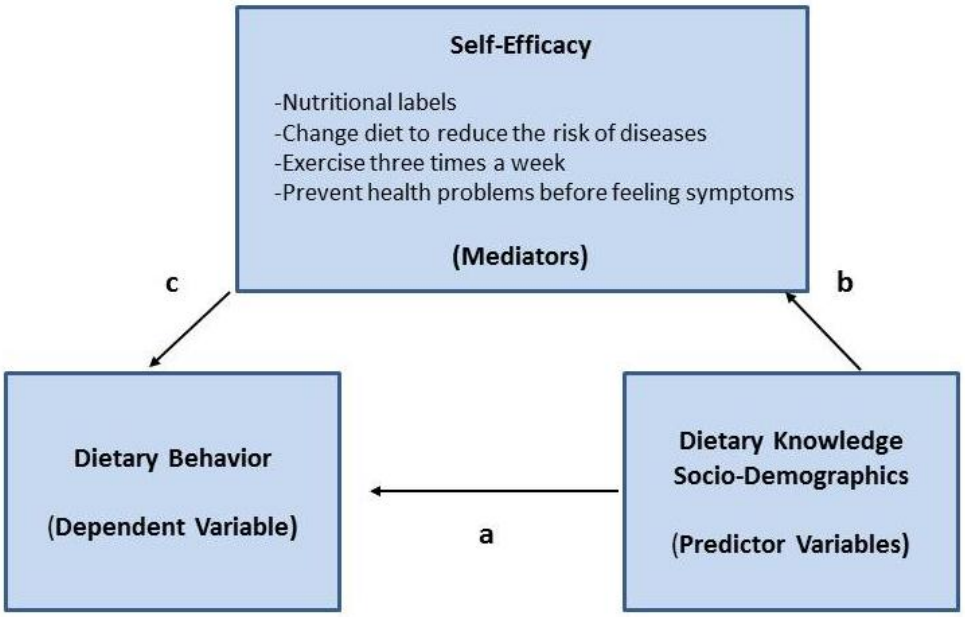

Figure 1. Conceptual model depicting the mediating role of self-efficacy between dietary behavior and predictor variables (adapted from Baron and Kenny, 1986).

Following Baron and Kenny (1986) and Judd and Kenny (1981), a series of regression models were developed to assess whether self-efficacy mediated the link between the predictor variables and dietary behavior:

Model 1: BEHAVIOR = b10 + b11 DIETARY KNOWLEDGE + e

Model 2: BEHAVIOR = b20 + b21 DIETARY KNOWLEDGE +b22 FFICACY + e

Model 3: BEHAVIOR = b30 + b31 DIETARY KNOWLEDGE + b32 FFICACY +b33 AGE + b34 GENDER + b35 INCOME+ b36 EDUC+ b37 RACE+ b38 HOUSEHOLD SIZE + e

Comparing estimated coefficients across Models 1 - 3 allows us to assess whether self-efficacy mediates the effects of the predictor variables on dietary behavior. To illustrate, assume that dietary knowledge exerts a statistically significant influence on behavior in Model 1. If dietary knowledge in the Model 2 has a negligible effect on behavior, it indicates that the effect of dietary knowledge is largely transmitted via the degree of self-control consumers can exercise on their diet and lifestyle. Second, if the effect of self-efficacy in Model 3 differs little from that in Model 2, it suggests that impacts of efficacy on diet behavior remain stable despite the presence of other predictors (socio-economic profile) in the model. The last case is a combination of the previous two: although the effects of efficacy in Model 3 are smaller than those in Model 2, they

remain statistically significant. This indicates that the effects of dietary knowledge are partially mediated by efficacy.

The empirical model posits that a participant's dietary behavior is a function of dietary knowledge, self control (efficacy) in changing health behavior with regard to food choices and life-style and various socio-economic characteristics of individuals. We are interested in explaining consumption intensity with regard to fruits, vegetables, and nutrients such as cholesterol and fat rather than number of times someone consumed them in the past. The model, therefore, can be formally written as:

$$Uj = \beta' Zj + \varepsilon j$$

Where Uj is a participant's actual dietary behavior and Zj is a vector of explanatory variables including participant's socio-economic profile. Although Uj is unobserved, what is observed is the expressed intensity of consumption represented by the rank-ordered dependent variables, R, where:

$$R = 0 \text{ if } Uj \leq 0$$
$$R = 1 \text{ if } 0 < Uj \leq \mu 1$$
$$R = 2 \text{ if } \mu 1 < Uj \leq \mu 2$$
$$R = w \text{ if } \mu w\text{-}2 < Uj$$

where the μ's are the threshold variables or cutoff points that provide the ranking of intensity in consuming specific dietary item. The lowest ranked outcome, R=0 represents the situation when a statement (e.g. I eat a lot of) regarding a specific dietary item does not represent a participant at all. Highest ranked outcome, R=w, represents the situation when a statement represents "extremely well."

The dependent variable in the models were measured using ordinal measures (1,2,3, 4 and 5.) Hence, an ordered probit model (Long 1997; Greene 1993) was used to conduct the regression analysis. Value of 1 indicated when a statement regarding a dietary item (e.g. I eat a lot of fresh fruits) did not describe a participant "at all"; value of 2 indicated that it described "slightly"; value of 3 indicated that it described "somewhat"; value of 4 indicated that it described "very well" and value of 5 indicated that it described "extremely well."

The Data

In the summer of 2007, a national survey among United States household was conducted. The survey was administered online by Ipsos-Observer, a private consulting firm specializing in consumer research and public opinion poll on socially important issue including tracking trends in food consumption. This firm maintains an on-line panel that consists of 400,000 households. Approximately stratified by geographic regions, income, education, and age to correspond to the 2000 US census, a sample of 9000 households were drawn out of the online panel in a manner that is representative of the US population. A total of 3,456 households completed the surveys, resulting in a 38.4% response rate. Sample households were sent e-mails soliciting information regarding their food consumption behavior and household characteristics. Each e-mail included a unique URL (keyed to the respondent's ID) to direct the respondent to the survey website. In

addition to socio-economic characteristics of sample households, survey instruments included questions relating to three key components in the mediating model: dietary knowledge, dietary behavior and diet related self-efficacy.

Respondents were asked dietary behavior questions about fresh fruits, fresh vegetables, fat and cholesterol (Table 1). They were asked to respond as to how well the statements described their dietary behavior using a scale of one to five where one represented "not at all" and five represented "extremely well." Four statements to measure diet related self-efficacy were read to the participants in the survey (Table 2). The respondents were asked "How likely are you to read nutritional labels on food packages carefully", "How likely are you to change diet to reduce the risk of certain diseases", "How likely are you to exercise at least three times per week" and "How likely are you to prevent health problems before feeling any symptoms" Respondents' reported self-efficacy were recorded on a 5-point scale. All responses were first coded such that the higher values represented high level of self-efficacy. Respondents were asked to respond as to how well the statements described the self-control (efficacy) in changing health behavior with regard to food choices and life-style. The lowest degree of self-control was represented by the response "extremely unlikely" and the highest degree of self control was represented by the response "extremely likely." The percentage of respondents who reported each level of self-control were reported in Table 2. A test was conducted to evaluate the internal consistency of the four statements. The computed test statistic showed that the four statements had a high level of consistency (Cronbach's $\alpha = 0.84$) in measuring levels of self-efficacy. A composite self-efficacy index was created by summing up the reported scores for each statement and dividing by four. The higher the index value the higher the overall level of self control.

Table 1. Food Consumption Behavior of US households (n=3056).

How well each of the statements describes you?	**I eat a lot of *fresh fruits***	**I eat a lot of *fresh vegetables***	**I am actively trying to consume *less fat* in my diet**	**I am actively trying to consume *less cholesterol* in my diet**
1 = Not at all	5.9%	5.5%	8.1%	12.2%
2 = Slightly	19.8%	17.0%	13.4%	16.1%
3 = Somewhat	33.8%	33.0%	31.8%	31.0%
4 = Very well	25.9%	29.2%	31.8%	26.7%
5 = Extremely well	14.5%	15.2%	14.9%	13.9%

Table 2. Reported level of self-control (Efficacy) in changing health behavior with regard to food choices and life-style (n=3056).

	Percentage of Respondents				
How likely are you to:	**1 = Extremely Unlikely**	**2 = Slightly**	**3 = Somewhat**	**4 = Very much**	**5 = Extremely Likely**
Read nutritional labels on food packages very carefully?	12.5%	19.5%	27.8%	24.6%	15.5%
Change diet to reduce the risk of certain diseases?	23.3%	18.9%	28.9%	20.1%	8.7%
Exercise at least three times per week?	25.9%	20.2%	19.6%	17.3%	16.9%
Prevent health problems before feeling any symptoms	9.0%	17.9%	35.2%	27.5%	10.4%

Note. Cronbach' s consistency test (α) was 0.85

A knowledge of the diet health relationship was measured using an instrument similar to the one used by Moorman and Matulich, (1993), who defined health knowledge as the extent to which consumers have enduring health-related cognitive structures Respondents were asked to link or match each of the eleven nutrients (i.e., sodium, calcium, vitamin A, protein, vitamin C, iron, vitamin D, carbohydrates, saturated fat, potassium, and dietary fiber) with an appropriate health consequence from a list: high blood pressure, strong bones, healthy eyes, amino acids, anticancer power, oxygen, absorb calcium, conversion to sugar and fueling the body, cardiovascular disease, and balancing sodium. An index of dietary knowledge was constructed by adding all correct answers for each respondent. Hence, the index ranges from a minimum of 0 (representing no dietary knowledge) to a maximum of 11 (representing highest dietary knowledge.) The mean dietary knowledge score was 6.09 (Table 3) which means an average respondent could provide six correct matches out of eleven.

Table 3 reports descriptive statistics for other (socio-economic) explanatory variables -including gender, age, household income, education level of the respondent, household size and ethnic background. Over 50% of the respondents were female. The average age of the respondent was 50 years. Household income was reported in income groups represented by numerical values. For example, 1 represented less than $5,000 and 25 represented more than $250,000. In the analysis, mid-points in each income group were used to obtain household income in dollars. The average household income among the sample respondents was $67,377. Average household size was 2.6 members. Nearly three fourths of respondents were white.

Table 3: Description of other explanatory variables used in the analysis.

VARIABLES	DESCRIPTION	Mean	Std. Deviation
Dietary Knowledge	Total number of dietary questions answered correctly (0 to 11).	6.085	3.142
Socio demographics			
Gender	1 = female; 0 = male	0.501	0.500
Age	Respondents' age in years	49.722	14.754
Income	1 = less than $5,000; 25 = $250,000 or more	$67,377	$38,292
Education	1 = college or more than college education; 0= otherwise	0.649	0.477
Household Size	Number of household member	2.612	1.399
Ethnic background	1 if white; 0 otherwise	0.734	0.442

A Pearson correlation matrix including all the independent variables was generated to examin any potential multicollinearity in the regression models. While many coefficients were statistically significant at 0.05 level, the size of the coefficient was very small. The largest coefficient was 0.21. Hence, it was determined that multicollinearity was unlikely in the proposed regression models

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Results and Implications

Ordered probit models for each of the four dietary behaviors: fresh fruits, fresh vegetables, fat and cholesterol were run and reported in Tables 4 to 7 (see Appendix). For all models the null

hypotheses that all parameters were jointly equal to zero were rejected using $\chi 2$ statistics at the 0.01 significance level. Based on the collinearity diagnostics (Belsley et al., 1980), no collinearity problems were detected in the analyses. Marginal effects of the independent variables were also estimated but not reported due to the space consideration. Initially, only knowledge was used as the explanatory variable. Self-efficacy and socio-demographic variables were added in subsequent runs.

The coefficients for the relationship between dietary behavior and knowledge are positive and significant, as one may have expected, in Model 1 of the all four dietary behaviors. This result suggests only that more dietary knowledge translates into more responsible and healthy dietary behavior, but it does not explain or clarify the mechanism or the process which leads more dietary knowledge to transfer into more responsible and healthy dietary behavior. This aspect of the problem is explained in Models 2 and 3.

In Model 2, when the influence of self-efficacy was added, the impact of dietary knowledge decreased but remained statistically significant for vegetables and fat while it became statistically insignificant for fruits and cholesterol. The coefficients measuring the impact of the self-efficacy on dietary behavior are all positive, statistically significant, and much larger in size than the coefficients associated with the knowledge variable. The pseudo R-squared for each of the four dietary items increased by a huge magnitude when self-efficacy was added to the models. All the above results from the regression analysis of Model 2 supported the hypothesized relationships that self-efficacy mediates effects of dietary knowledge and social influences on dietary behavior for each of the four dietary items.

Self-efficacy also accounted for variance in eating behavior not explained by knowledge or demographic variables. However, the effect of self-efficacy on dietary behavior in Model 3, albeit remaining statistically significant, decreased substantially in the cases of both fat and cholesterol. Moreover, the pseudo R-squared in these two regressions decreased when demographic variables were added. While the impact of all demographic variables on the dietary habits in fruit consumption behavior equation is statistically significant, and the impact of all demographic variables but the education is statistically significant in the vegetables consumption behavior equation, the demographic variables had almost no impact on consumption of fat (except age) and cholesterol (except the household size).

The above results indicate that self-efficacy is the most important mechanism in impacting fat and cholesterol consumption, while it is only one of the factors impacting the consumption of both fruits and vegetables. This should come as no surprise: healthy nutrition implies eating more of fruits and vegetables for most people while cutting out the consumption of fat and cholesterol. Consuming more of anything is hardly considered a sacrifice while consuming less of something often demands a great deal of self-control and discipline. The results in this study are consistent with results in other studies which show that dieting, weight control and preventive nutrition can be governed by self-efficacy beliefs. In intervention programs, clients with higher level of self-control were less likely to relapse into their previous habit than those with lower level of self-control (Chambliss and Murray 1979; Furhrmann and Kuhl 1998;

Schnoll and Zimmerman 2001; Long and Stevens. 2004; Luszczynska et al. 2007). Yet there is no clear unique solution as for what the means to inducing dietary self-efficacy may be. For example, some studies suggest that goal setting is the most critical way to induce self-efficacy in dietary behavior (e.g., Robinson 1999; Baldwin and Galciglia 1997). Other studies suggest that goal setting and self-monitoring combined increase the self-efficacy scores significantly (e.g., Schnoll and Zimmerman 2001). Also, other aspects of self-regulation and behavioral training such as problem identification, problem solving, self-evaluation, or reinforcement may be critical in inducing dietary self-efficacy (Hardeman et al. 2000). Hence, interventions and health promotion campaigns should seek to directly address factors influencing diet related self-efficacy instead of focusing on disseminating information only. In practice, for example, we often see healthy foods such as fruits and vegetables being introduced on the menus of school and college cafeterias or in restaurants. The availability of healthy foods coupled with self-efficacy driven by dietary knowledge is likely to lead to an increased consumption of healthy foods. At the same time, most restaurants and cafeterias sell foods rich in fat and cholesterol alongside the healthy foods. Also, while often the consumers are aware of the negative impact fat and cholesterol may have on their health due to numerous educational activities by health and nutrition professionals, the low cost of that food coupled with the sugar enhanced, taste improving additives proves to be irresistible to the average consumer (Miljkovic, Nganje, and de Chastenet 2008). It has been shown that sweetened foods, i.e., an increased consumption of sugar, leads first to sugar addiction and second to carbohydrate addiction and increased consumption of fats (Miljkovic and Nganje 2008). Hence unavailability of unhealthy food or its availability at higher cost due to "fat tax," especially to children and adolescents who develop taste for unhealthy foods at an early age, seems to be a reasonable pro-active approach to influence diet related self-efficacy.

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Appendix

Table 4. Mediation by *efficacy* in the relationship between dietary knowledge and fruit consumption behavior: An Ordered Probit Model

	Model1		Model2		Model3	
Variables	Coeff.	P-value	Coeff.	P-value	Coeff.	P-value
ONE	1.399	0.000	0.265	0.000	-0.154	0.142
KNOW	0.028	0.000	0.002	0.706	-0.006	0.317
EFFICACY			0.563	0.000	0.551	0.000
AGE					0.005	0.000
GENDER					0.215	0.000
INCOME					0.001	0.005
EDUCA					0.090	0.036
RACE					-0.125	0.003
HHSIZE					0.043	0.001
Mu(1)	0.914	0.000	1.012	0.000	1.025	0.000
Mu(2)	1.812	0.000	2.006	0.000	2.031	0.000
Mu(3)	2.628	0.000	2.910	0.000	2.945	0.000
Pseudo-R-Squared*	0.01		0.32		0.35	

*$R^2_{ML} = 1 – \exp(-G^2/N)$, where $G^2 = -2 \ln [L(M_\alpha)/L(M_\beta)]$; M_α = restricted likelihood, M_β = Unrestricted Likelihood, and N=Number of observation (Maddala. 1983).

Table 5. Mediation by *efficacy* in the relationship between dietary knowledge and vegetable consumption behavior: An Ordered Probit Model

	Model1		Model2		Model3	
Variables	Coeff.	P-value	Coeff.	P-value	Coeff.	P-value
ONE	1.361	0.000	0.171	0.008	-0.415	0.000
KNOW	0.041	0.000	0.016	0.005	0.007	0.286
EFFICACY			0.592	0.000	0.579	0.000
AGE					0.008	0.000
GENDER					0.246	0.000
INCOME					0.002	0.000
EDUCA					0.050	0.243
RACE					-0.115	0.007
HHSIZE					0.041	0.002
Mu(1)	0.853	0.000	0.955	0.000	0.976	0.000
Mu(2)	1.756	0.000	1.962	0.000	2.002	0.000
Mu(3)	2.649	0.000	2.960	0.000	3.016	0.000
Pseudo-R-Squared*	0.03		0.36		0.39	

*$R^2_{ML} = 1 – \exp(-G^2/N)$, where $G^2 = -2 \ln [L(M_\alpha)/L(M_\beta)]$; M_α = restricted likelihood, M_β = Unrestricted Likelihood, and N=Number of observation (Maddala. 1983).

Table 6. Mediation by *efficacy* in the relationship between dietary knowledge and fat consumption behavior: An Ordered Probit Model

	Model1		**Model2**		**Model3**	
Variables	Coeff.	P-value	Coeff.	P-value	Coeff.	P-value
ONE	1.087	0.000	-0.617	0.000	0.524	0.000
KNOW	0.055	0.000	0.019	0.002	0.025	0.000
EFFICACY			0.889	0.000	0.128	0.000
AGE					0.006	0.000
GENDER					0.034	0.368
INCOME					0.001	0.125
EDUCA					0.012	0.773
RACE					-0.003	0.942
HHSIZE					0.006	0.656
Mu(1)	0.621	0.000	0.782	0.000	0.607	0.000
Mu(2)	1.507	0.000	1.902	0.000	1.481	0.000
Mu(3)	2.475	0.000	3.120	0.000	2.439	0.000
Pseudo-R-Squared*	0.05		0.60		0.26	

*$R^2_{ML} = 1 – \exp(-G^2/N)$, where $G^2 = -2 \ln [L(M_\alpha)/L(M_\beta)]$; M_α = restricted likelihood, M_β = Unrestricted Likelihood, and N=Number of observation (Maddala. 1983).

Table 7. Mediation by *efficacy* in the relationship between dietary knowledge and cholesterol consumption behavior: An Ordered Probit Model

	Model1		**Model2**		**Model3**	
Variables	Coeff.	P-value	Coeff.	P-value	Coeff.	P-value
ONE	0.932	0.000	-0.662	0.000	0.384	0.000
KNOW	0.040	0.000	-0.009	0.147	0.004	0.542
EFFICACY			0.846	0.000	0.333	0.000
AGE					0.002	0.077
GENDER					-0.023	0.556
INCOME					0.000	0.382
EDUCA					-0.012	0.773
RACE					-0.054	0.201
HHSIZE					-0.038	0.004
Mu(1)	0.598	0.000	0.748	0.000	0.590	0.000
Mu(2)	1.413	0.000	1.768	0.000	1.416	0.000
Mu(3)	2.265	0.000	2.839	0.000	2.279	0.000
Pseudo-R-Squared*	0.03		0.60		0.29	

*$R^2_{ML} = 1 – \exp(-G^2/N)$, where $G^2 = -2 \ln [L(M_\alpha)/L(M_\beta)]$; M_α = restricted likelihood, M_β = Unrestricted Likelihood, and N=Number of observation (Maddala. 1983).