Effects of the nutritional labels use on healthy eating habits in Spain

Význam používání údajů o nutriční hodnotě na obalu výrobků k dosažení zdravějších stravovacích návyků ve Španělsku

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Abstract: This study aims at testing a theoretical model explaining why people follow healthy eating habits and in particular to identify how the nutritional labels use influences this behavioural pattern. The results indicate that the individuals who utilise more often the nutritional labels follow healthier eating habits, such as avoiding snacking between meals, a lower intake of salt and avoiding the fat intake. According the factors explaining the label use, the health knowledge, the bad health status and being aware of the diet-health relation are found significant. Age and household size are the socio-demographic variables which also affect the nutritional label use and eating habits. Findings provide more evidence on the consumers' underlying motivations to pay attention to nutritional labelling, which allows evaluating the impact of the implementation of the Regulation EC 1924/2006 of the European Parliament and the Council of 20 December 2006 on nutritional and health claims made on foods (Regulation EC 1924/2006). In addition, empirical results could help the local policy makers to establish appropriate market strategies to increase healthy eating habits by promoting the nutritional label use by consumers.

Key words: nutritional labels, healthy eating habits, structural equation modelling, Spain

Abstrakt: Studie je změřena na testování teoretického modelu vysvětlujícího, proč se lidé řídí zásadami zdravé výživy, a zejména identifikujícího způsob, jakým nutriční údaje na obalu výrobků ovlivňují tyto vzorce chování. Výsledky naznačují, že jedinci, kteří častěji využívají těchto informací o nutričním obsahu se řídí zdravějšími stravovacími návyky, jako je vyhýbat se konzumaci potravin mezi hlavními jídly, nižší spotřeba soli a omezená konzumace tuků. Pokud jde o faktory vysvětlující využití informací na obalu, jako významné byly shledány znalost vlastního zdraví, špatný zdravotní stav a znalost vztahů mezi zdravím a složením stravy. Věk a velikost domácnosti patří mezi socio-demografické proměnné, které také ovlivňují využití informací na obalu produktů a stravovací návyky. Získané údaje poskytují další podklady týkající se motivace spotřebitelů vyžívat nutriční informace na obalu produktů, což dále umožňuje hodnocení významu implementace nařízení Evropského parlamentu č. EC 1924/2006 a Rady Evropy o nutričních a zdravotních požadavcích týkajících se potravin z 20. 12. 2006 (Nařízení EC 1924/2006). Empirické výsledky výzkumu mohou navíc pomoci lokálním politikům vytvořit vhodné tržní strategie ke zvýšení úrovně zdravých stravovacích návyků zavedením nutričních informací na obalu produktů pro spotřebitele.

Klíčová slova: nutriční údaje na obalu produktu, zdravé stravovací návyky, modelování strukturálních rovnic, Španělsko

Following a balanced nutritional diet is considered one of the most important aspects to prevent the cardiovascular diseases, cancer, diabetes and obesity, which represent a major cause of death, and will account for 75% of deaths in the world by 2020 (WHO 2003). However, a policy action is important in this field especially when these illnesses could be partially prevented by following the healthy eating habits (i.e. regular physical activity, moderate alcohol consumption, avoidance of smoking, etc.). To illustrate, in order to promote the overall health status in the EU, the European authorities have laid down in the White Paper on nutrition, overweight and, obesity related health issues (European Commission

2007) some specific auctions to improve the eating habits by supporting the nutritional knowledge. Even thought the inclusion of nutrition facts is voluntary, the regulation of this type of claims ensures that consumers have access to more information of the intrinsic food attributes in order to allow them to follow a balanced diet.

In the empirical literature, factors affecting the consumers' nutritional knowledge and nutritional labeling use have been subject to numerous investigations (Guthrie et al. 1995; Wang et al. 1995; Nayga 1996, 2000; Piedra et al. 1996; Shine et al. 1997; Szykman et al. 1997; Nayga et al. 1998; Govindasamy and Italia 1999; Kim et al. 2000, 2001a; Mc-Lean-Meyinsse 2001; Cowburn and Stockley 2005; Drichoutis et al. 2005, 2006; Mannell et al. 2006; Gracia et al. 2007; Grunert and Wills 2007). The importance of some factors can be concluded from the revision of these papers. First, there is no consistency of the sign of the effect of the socio-demographic characteristics on the nutritional label use. Although the level of education has been found to positively affect the nutritional label use and females have been found more likely to use nutritional labels than males (Guthrie et al. 1995; Nayga 1996; Nayga et al. 1998; Govindasamy and Italia 1999; McLean-Meyinsee 2001; Kim et al. 2001a; Drichoutis et al. 2005), there has been no consensus on the effect of age, income and household size (Guthrie et al. 1995; Wang et al. 1995; Piedra et al. 1996; Nayga 1996; Schupp et al. 1998; Govindasamy and Italia 1999; McLean-Meyinsse 2001; Kim et al. 2001a; Lin and Lee 2003; Drichoutis et al. 2005; Gracia et al. 2007). Second, the factors influencing the nutrition label use go beyond the classic socio-demographics and include also the individual nutritional knowledge, health status, importance given to the nutrition attributes by the consumers, and their awareness regarding the diet- health relationship (Guthrie et al. 1995; Wang et al. 1995; Shine et al. 1997; Nayga et al. 1998; Nayga 2000; Kim et al. 2000, 2001a, b; Drichoutis et al. 2005; Gracia et al. 2007).

While there have been published several papers on the nutritional label in the academic literature, a scarce number of studies have paid attention to the effect of nutritional information use on the promotion of healthier eating habits. The limited evidence in this sense is due to the difficulties associated with obtaining data on the actual consumption and eating habits. One option to overcome this lack of data availability is to calculate the intake of certain nutrients based on the average content in the purchased items. This has been done both for the elements considered damaging for human health (i.e. cholesterol or sugars), and for the nutrients considered healthy (i.e. fiber). Alternatively, a general index of healthful diet can be constructed (Guthrie et al. 1995; Teisl and Levy 1997; Variyam et al. 1996, 1998; Kim et al. 2000, 2001b; Weaver and Finke 2003).

Our research is in line with these studies and the main objective is to investigate whether a higher consumers' use of the nutritional labels positively improves the consumers' eating habits in Spain, using the self-reported eating habits data. In particular we identify: (*i)* which factors affect the nutritional label use and (*ii)* the influence of the nutritional label use on the consumers' diet quality. Our findings provide more evidence on the consumers' underlying motivations to use the nutritional labeling to that already existing in Europe. In addition, the results can help the local policy makers to establish the appropriate market strategies to promote the nutritional label use by consumers and to improve the European consumers' health. These results will provide evidence to evaluate whether the implementation of the Regulation EC 1924/2006 of the European Parliament and the Council of 20 December 2006 on nutritional and health claims made on foods (Regulation EC 1924/2006) will have any impact on improving the overall eating habits of Europeans and therefore provide benefits in the form of the reduced diet related diseases.

This study uses the data from a survey to 800 food shoppers conducted during the spring of 2007 in two medium-sized Spanish cities; and it applies the structural equation modeling (SEM) approach. The rest of the paper is structured as follows. It begins by presenting the conceptual model and the hypotheses. It follows by describing the variables. Section 4 presents the empirical application and the results and, finally, section 5 concludes with a discussion of the policy implications.

RESEARCH FRAMEWORK AND HYPOTHESES SPECIFICATION

Drichitous et al. (2005) develop a conceptual framework which supports a positive link between the nutritional label use and the purchase behaviour. In their framework, the nutritional label use depends on: (*i*) consumer socio-demographic characteristics (age, gender and education), (*ii*) situational, behavioural and attitudinal factors (income, working status, time spent shopping, special diet status, diet-health awareness, type of household, area of residence, etc.), (*iii*) product involvement factors (price, nutrition and taste), (*iv*) nutritional knowledge and, (*v*) other factors (scepticism and attitudes toward nutrition).

Their underlying hypotheses is that the nutritional label information will lead to dietary changes, improving diet quality, by influencing the valuations and perceptions consumers have of the different food products. In addition, since healthy diet consists of a number of different foods, it is measured by individual's self-assessment of eating habits (Pieniak et al. 2008)

Previous research has tried to identify the effects of nutritional label use on consumers' eating habits (Guthrie et al. 1995; Teisl and Levy 1997; Variyam et al. 1996, 1998; Kim et al. 2000, 2001b; Weaver and Finke 2003). Their findings are summarized following. Guthrie et al. (1995) analyzed the effect of nutritional labelling on healthy diet measured by intakes of different nutrients (proteins, fats, fibre, cholesterol, etc.). The results indicated that the nutritional knowledge provided by food labels improved consumers' diet as cholesterol's intake went down and vitamin C's intake increased.

Teisl and Levy (1997) investigated the impact of the introduction of nutritional labelling programmes on the demand for six different product categories considering healthy and unhealthy goods within each category. Their results show that providing nutritional information on food labels reduced unhealthy nutrients intake by increasing the purchase of the healthier goods within each category.

Variyam et al. (1996, 1998) analyzed the effects of nutritional information in the consumption of different nutrients (cholesterol and fibre). The results indicated that more nutritional information leads to smaller intakes of cholesterol and greater intakes of fibre. Kim et al. (2000, 2001a) analyzed the effect of consumer label use on selected nutrient intakes, indicating that nutritional label use reduces individual's intake of calories, cholesterol and sodium while it increases intakes of fibre. Last, Weaver and Finke (2003) studied the effect of nutritional label use on sugar consumption. They found that consumers always using information on nutrition facts panels consume less of their total energy in form of added sugars than consumers who do not use the labels. However, the use of general nutritional information had no impact on the consumption of products with added sugar. Thus, based on these findings, we can establish the first casual relation between nutritional label use and improvement of eating habits.

H1: *Higher consumers' use of nutritional labels would positively influence consumers' healthier eating habits. As consumers increase the use of nutritional label, their eating habits are more likely to improve.*

A relevant factor affecting nutritional label use is nutritional knowledge. The positive effect of nutrition knowledge on label use has been explained due to the increased capacity to understand the information provided in labels by those consumers with higher nutritional knowledge. Moreover, it cannot be discarded that the use of nutritional labels also increases the nutritional knowledge of consumers. Guthrie et al. (1995); Nayga (2000); Kim et al. (2001b); Drichoutis et al. (2005) and Gracia et al. (2007) confirm in their studies that consumers with higher nutrition knowledge are more likely to use nutrition labels when food shopping. Then, according to these findings, the second hypothesis can be stated as follows:

H2: *Higher consumers' level of nutrition knowledge leads to higher use of nutritional labels.*

Several studies show that consumers who are aware of the diet-health relationship are also more likely to use nutritional labels (Wang et al. 1995; Shine et al. 1997; Kim et al. 2000, 2001b). Shine et al. (1997) and Kim et al. (2001b) show that consumers who use nutritional labels strongly agree with the statement that there is a direct relationship between diet and diseases. Wang et al. (1995) show that consumers with lower levels of health awareness are less likely to use food labels as a source of nutrition information. Kim et al. (2000) show that individuals more informed about the link between diet and health problems and who are on special diets are more likely to use this type of labels. Therefore, the third hypotheses can be defined as follows:

H3: *Higher consumers' awareness of the diet-health relationship leads to higher use of nutritional labels.*

Finally, looking at the effect of socio-demographic characteristics on nutritional label use, the empirical evidence shows that there is no consensus whether the effect of some socio-demographic characteristics on nutritional label use is positive or negative. Several empirical papers (Guthrie et al. 1995; Wang et al. 1995; Nayga 1996, Nayga et al. 1998; Kim et al. 2001a; McLean-Meyinsse 2001; Drichoutis et al. 2005) found that consumers with higher education use nutritional label more, because they are more likely to search for higher levels of information before purchasing and are able to better process the information included in the labels. Moreover, Guthrie et al. (1995), Govindasamy and Italia (1999), Kim et al. (2001a, 2001b). McLean-Meyinsse (2001) show that women use nutritional labels more than males because they are more acquainted with them.

Similarly, older people have higher probability of suffering health problems and they are greater concern on the healthiness of food they eat. Older consumers are expected to be more likely to use nu-

tritional labels (Nayga 1996; Kim et al. 2000; Lin and Lee 2003; Govindasamy and Italia 1999; Drichoutis et al. 2005, 2006).

Drichoutis et al. (2006) put forward that income could have positive or negative effects on nutritional label use depending on whether they are considered either as a signal of greater interest in nutritional issues (positive effect) or as a proxy of higher opportunity cost of time (negative effects). Evidence supports both that income can have a positive effect on nutritional label use (Wang et al. 1995; Piedra et al. 1996; Kim et al. 2001a; McLean-Meyinsse 2001) and the contrary (Schupp et al. 1998; Drichoutis et al. 2005).

Regarding to household size, most of studies show that there is a negative impact on nutritional label use (Guthrie et al. 1995; Govindasamy and Italia 1999; Drichoutis et al. 2006; Gracia et al. 2007) due to stronger time constraints, although some studies show that this relationship is positive (Wang et al. 1995; Nayga 1996) due to increased concern with caring for the overall household health status. From this review, we can identify the last hypothesis consisting of 5 sub-hypotheses:

H4.1: Highly educated consumers are more likely to use nutritional labels when shopping food.

H4.2: Women are more likely to use nutritional labels when shopping food than men.

H4.3: Older consumers are more likely to use nutritional labels when shopping food.

H4.4: Consumers with higher level of income are more likely to use nutritional labels when shopping food.

H4.5: Consumers living in households of small size are more likely to use nutritional labels when shopping food.

This section is summarized in Table 1, which shows the factors proposed by Drichitous et al. (2006) and the empirical evidence found in the literature regarding the casual relationships posed in the model.

METHOD

Questionnaire

Data were collected from a survey conducted in two medium-sized Spanish towns, Cordoba and Zaragoza[1], during March and April 2007. These towns were selected to be representative of both the North and the South of the Country. Zaragoza was chosen because it is a town widely used by food marketers and consulting companies since the socio-demographic profile of this town is representative of the Spanish Census of Population. Córdoba was chosen because it also partly fulfils the same characteristic for population distribution. The questionnaire was designed to analyse the relationship between consumers' health and diet concerns and food choices. In particular, consumers were asked questions related to health

Table 1. Proposed model and hypotheses specification

Hypothesis	Factors	Sign	Researches
H1	Nutrition label use on healthy eating habits	+	Guthrie et al. (1995); Teisl and Levy (1997); Variyam et al. (1996, 1998); Kim et al. (2000, 2001a); Weaver and Finke (2003)
H2	Knowledge	+	Guthrie et al. (1995); Nayga (2000); Kim et al. (2001b); Drichoutis et al. (2005); Gracia et al. (2007)
H3	Diet-health awareness	+	Shine et al. (1997); Wang et al. (1995); Kim et al. (2000, 2001b); Drichoutis et al. (2005)
H4.1	Education	+	Guthrie et al. (1995); Nayga (1996), Nayga et al. (1998); McLean-Meyinsee (2001); Kim et al. (2001a); Drichoutis et al. (2005)
H4.2	Female	+	Guthrie et al. (1995); Govindasamy and Italia (1999); Kim et al. (2001a, b); McLean-Meyinsse (2001)
H4.3	Age	+	Nayga (1996); Govindasamy and Italia (1999); Lin and Lee (2003); Drichoutis et al. (2005)
H4.4	Income	+	Wang et al. (1995); Piedra et al. (1996); McLean-Meyinsse (2001); Kim et al. (2001a)
H4.5	Household size	–	Guthrie et al. (1995); Govindasamy and Italia (1999); Drichoutis et al. (2006); Gracia et al. (2007)

Source: casual relationships justify by empirical evidence and Drichoutis et al. (2006)

[1]The total population is around 700 000 and 350 000 inhabitants in Zaragoza and Cordoba, respectively.

Table 2. Sample characteristics (%, unless stated) and exogenous variables definition

Variable definition	Value	
	Zaragoza	Cordóba
Individual characteristics		
Gender	65	79
Male	35	21
Female		
Age (average from total sample)	37.6	39.8
Education of respondent		
Elementary School (1)	21	38
High School (2)	36.5	31
University (3)	42.5	30
Economic conditions and time pressure		
Average household income (€)		
below 600	1.3	3
600–1 500	16.3	14.8
1 501–2 500	38.6	54.6
2 501–3 500	21.8	17.3
3 501–4 500	13.3	7
more than 4 500	9	3.5
Household size (average from total sample)	3.1	3.1
Household with kids less than 6 years old (1 = Yes)	20	25

habits and status, nutritional and health knowledge and food label use. The questionnaire also contained questions on socio-demographic characteristics (i.e. sex, family size and composition, age, education level, income) and consumers' eating habits. Prior to the main survey, this questionnaire was validated using a pilot survey of 20 consumers in each town to test for understanding and interview length.

Sample size in both towns was set at 400. As both populations can be considered infinite, this sample size results in a sampling error of ±5%, assuming a confidence level of 95.5% ($k = 2$) and $P = 0.5$. A stratified random sample of consumers was made on the basis of town district and age. A number of representative grocery stores and supermarkets were selected in each town district, and food shoppers were randomly selected outside these food outlets. Target respondents were the primary food buyers in the household and interviews carried out face to face. Interviewers approached the randomly selected individuals asking them one screening question, whether they were the main household food shopper. Summary statistics for the characteristics of two sub-samples (Zaragoza and Cordoba) are presented in Table 2.

Definitions of variables and measurement of constructs

The healthy food choice construct (HEALTHY EATING HABITS) was measured by different questions related to how much they considered that their eating habits avoided fat (AVOID_FAT) and salt intake (MOD_SALT), adhered to a balanced diet (HEALTY_DIET) and avoided eating outside the main meals (AVOID_SNACKING). Their assessments were measured using a 10-point increasing scale where ten meant the highest level of agreement.

The nutritional label use construct (NUTRITIONAL LABEL USE) was measured asking to consumers how often they use three different types of nutrition information present in food products when shopping; the list of ingredients (INGRED_USE), the nutritional facts panel (PANEL_USE) and the health/nutrition claims (CLAIM_USE). These variables were ordered variables ranging from one to four, with frequency of use increasing with the variable value (Table 3).

The knowledge about how healthy food products are (HEALTHY-DIET KNOWLEDGE) was measured asking to consumers to rate what they think that following a healthy diet meant (eat more fruit and vegetables, reduced fat products intakes and reduced intakes of sugar). Their assessments were measured using an increasing scale from 1 to 10 where 10 was the maximum agreement with the specific habit (HEALTH_FRUIT, HEALTH _FAT, and HEALTH _SUGAR).

Finally, in order to measure the diet-health awareness, consumers were asked to rate to what extent they believe that their diet choice affects their health status using a 10 point increasing scale (HEALTHY).

Table 3. Measurement of the exogenous and endogenous variables

Factors	Observed variables	Score	Variable name
HEALTHY EATING HABITS	I avoid fat in the food I eat	1 = strongly disagree ..... 10 = strongly agree	AVOID_FAT
	I follow a healthy diet	1 = strongly disagree ..... 10 = strongly agree	HEALTHY_DIET
	I avoid eating between meals	1 = strongly disagree ..... 10 = strongly agree	AVOID_ SNACKING
	I moderate my salt intake	1 = strongly disagree ..... 10 = strongly agree	MOD_SALT
NUTRITIONAL LABEL USE	Consumer uses the list of ingredients when shopping	4 = always 3 = often 2 = once in a while 1 = never	INGRED_USE
	Consumer uses the nutritional facts panel label when shopping	4 = always 3 = often 2 = once in a while 1 = never	PANEL_USE
	Consumers uses a nutritional/ health claim label when shopping	4 = always 3 = often 2 = once in a while 1 = never	CLAIM_USE
HEALTHY-DIET KNOWLEDGE	Consumers considers that they follow a healthy diet whether		
	Eat more fruit and vegetables	1 = no association ..... 10 = strongly association	HEALTH_FRUIT
	Have a lower fat intake	1 = no association ..... 10 = strongly association	HEALTH_FAT
	Have a lower sugar intake	1 = no association ..... 10 = strongly association	HEALTH_SUGAR
FOOD-HEALTH	Consumers self-assessment of the importance of food intake on their health status	1 = no important .... 10 = very important	HEALTHY

RESULTS AND DISCUSSION

Structural equation modeling was applied to test the proposed model and casual relationships among endogenous and exogenous variables defined as latent factors, each of which was measured by direct variables. In agricultural marketing, several studies have applied this methodology to analyze organic consumer behavior (Chen 2007; de Magistris and Gracia 2008), genetically modified products (Chen 2008; Kim 2009), Designation of Origin food products (Espejel et al. 2008) and healthy eating habits (Pieniak et al. 2008).

In accordance to Byrne (2001), total sample was divided into two sub-samples according to two cities, Zaragoza and Cordoba. The χ^2 value of 293.9 with 84 degree of freedom provides the baseline value against the χ^2 value of 301 with 87 degree of freedom testing for the invariance of structural parameters across consumers of two sub-samples. This comparison yields a χ^2 differences value of 7 with 3 degree of freedom is not statistically significant at the 0.05 probability level. Findings suggest that the assessment of the overall fit of the proposed model is done considering the pooled data, as this ensures the validity of results for both towns.

Testing the measurement and structural model

The first step in the structural equation modelling process is to validate the measurement model,

Table 4. Confirmatory Factor Analysis results. Standardized parameter estimates for the measurement model

Variables	Cronbach's α	Standardize factor loading	*t*-value
HEALTHY EATING HABITS (F1)	0.65		
AVOID_FAT		0.66	10.324 ($P < 0.001$)
HEALTHY_DIET		0.58	9.860 ($P < 0.001$)
AVOID_SNACKING		0.50	9.141 ($P < 0.001$)
MOD_SALT		0.53	(0.000)[a]
NUTRITIONAL LABEL USE (F2)	0.743		
INGRED_USE		0.79	13.088 ($P < 0.001$)
PANEL_USE		0.75	13.102 ($P < 0.001$)
CLAIM_USE		0.54	(0.000)[a]
HEALTHY-DIET KNOWLEDGE (F3)	0.772		
HEALTH_FRUIT		0.66	(0.000)[a]
HEALTH_FAT		0.92	15.033 ($P < 0.001$)
HEALTH_SUGAR		0.64	15.708 ($P < 0.001$)
FOOD HEALTH (F4)			
HEALTHY		1.00	(0.000)[a]

[a]Values were not calculated because loading was set to 1.0 to fix construct variance

*Significant at the 0.001 significant level

applying a confirmatory factor analysis where the factors are the latent variables. The adequacy of the measurement model is evaluated by: (i) reliability of each of the constructs which is evaluated by the Alpha coefficient and the statistical significance of indicator loadings; and (ii) the discriminate validity.

Reliability refers to the consistency of the measurement. Results presented in table IV indicate that the Alpha values exceed the recommended level of 0.70 for HEALTHY-DIET KNOWLEDGE and NUTRITIONAL LABEL USE whereas the Alpha parameters relating to HEALTHY EATING HABITS are closed to this level.

Convergent validity is evaluated by the *t*-ratio for the factor loadings. Table 4 shows that the *t*-values associated with each of the loading for each value exceed the critical values at 1% of significance. This means that all variables are statistically significant in their respective constructs, supporting the hypothesized relationships between indicators and constructs.

Finally Table 5 presents the statistically significant correlations among 4 constructs, then, we can conclude that the fit of the measurement model is quite reasonable.

Discriminate validity of two constructs is tested by focusing on the correlations between different constructs, as measured by their respective indicators. It is achieved if these are relatively weak. A χ^2 difference test is used to assess the discriminate validity of two constructs, the test is undertaken by calculating the difference of the χ^2 statistics for the constrained and unconstrained measurement

Table 5. Reliability analysis: correlation matrix of the constructs

Construct	Healthy diet knowledge	Healthy eating habits	Nutritional label use	Food_health
Healthy diet knowledge	1	0.321	0.154	0.208
Healthy eating habits	0.321	1	0.320	0.262
Nutritional label use	0.154	0.320	1	0.223
Food_health	0.208	0.262	0.223	1

Table 6. Discriminate validity for the measurement model

Construct pair	Standard measurement model $\chi^2_{(39)} = 124.3$ ($P < 0.0001$)	
	uni-dimensional model χ^2 (40)	χ^2difference
(F1, F2)	222.22	97.92
(F1, F3)	153.4	29.1
(F1, F4)	144.6	20.3
(F2, F3)	406.4	282.1
(F2, F4)	364.5	240.2
(F3, F4)	246.4	122.1

Table 7. SEM results: standardized parameter estimates for the Structural Model

			Parameters	*t*-values
NUTRITIONAL LABEL USE	→	HEALTHY EATING HABITS	0.50	7.65 ($P < 0.001$)
HEALTHY-DIET KNOWLEDGE	→	NUTRITIONAL LABEL USE	0.20	4.59 ($P < 0.001$)
FOOD_HEALTH	→	NUTRITIONAL LABEL USE	0.24	5.72 ($P < 0.001$)

models. The constrained model is identical to the unconstrained model, in which all constructs covary, except that the correlation between the two constructs of interests is fixed at 1 (Chen 2007). The Bonferroni method was used where, under the overall 0.001 significance level, the critical values of the $\chi^2_{(1)}$ is 11.56. Table 6 displays the χ^2 difference tests for the different pairs of constructs. Because all of the difference tests exceed the critical value, the model is considered to achieve discriminate validity.

The model component connecting the endogenous and exogenous variables is called the structural model. The structural coefficients in the model have been estimated using the Maximum Likelihood Estimation procedure (MLE) with the AMOS 5.0 computer software. Table 7 presents the standardized parameter estimates for the structural model, the *t*-ratios and the single-headed arrows casual relations.

Standardized structural coefficient estimates are used to compare the relative importance of the independent variables. The results indicate that all the *t*-values for the standardized coefficients are above the 95% critical value and are thus significantly different from zero.

This assessment of the overall fit of the proposed model which ensures an adequate representation of the entire set of casual relationships is presented in Table 8, where measures of absolute fit (CFI and RMSEA), incremental fit (IFI) and parsimonious fit (PRATIO) are reported. Absolute fit measures determine the degree at which the overall model (structural and measurement models) predicts the observed covariance or correlation matrix. The likelihood-ratio chi square (χ^2) value is statistically significant at the 5% level[2]. Since the chi-square statistic is very sensitive to sample size, other measures are examined to assess the model goodness of fit. The RMSEA value is 0.077, which indicates a reasonable error of approximation.

Table 8. Model Goodness-of-fit

Measures	Optimum	Estimated model
Absolute fit measures		
χ^2		242.1
g.l		42
P	$P > 0.05$	0.000
RMSEA	(0.05–0.08)	0.077
Incremental fit measures		
TLI	> 0.90	0.90
NFI	> 0.90	0.89
IFI	> 0.90	0.902
CFI	> 0.90	0.901
Parsimonious fit measures		
χ^2/g.l	(1–6)	5.4
PRATIO	close to 1	0.77

Source: Arbuckle and Wothke (2004)

[2]For a χ^2 with 42 degrees of freedom.

Table 9. Results of simultaneous test of unrestricted Model: Goodness of fit statistics

	χ^2	d.f	χ^2/d.f	*P*	IFI	CFI	RMSEA
EDUCATION model	209.4	84	3.45	0.00	0.90	0.90	0.055
SEX model	316.961	84	3.77	0.00	0.89	0.89	0.06
AGE model	166	84	1.978	0.00	0.90	0.90	0.056
INCOME model	359.5	126	2.85	0.00	0.89	0.89	0.048
HOUSEHOLD model	326.9	84	3.89	0.00	0.89	0.89	0.060

Thus, these results support that there is a good correspondence between the resulting model-implied covariance matrix and the empirical or data based covariance matrix. Regarding the comparisons to a baseline model, the IFI, and the CFI values indicate that the proposed model can be acceptable. Finally, the parsimony fit measures represents the degree of model fit per estimated coefficient. These measures attempt to correct any "over fitting" of the model and evaluate the parsimony of the model compared to the goodness-of-fit (Hair et al. 2001). The results indicate that the model is parsimonious as the PRATIO value is close to 1 and $\chi^2/42$ is included between the interval values (Arbuckle and Wothke 2004).

Testing for invariant pattern of casual structure

Following Byrne (2001), the last hypothesis concerning the socio-demographic characteristics has been verified using a test for invariance of structural parameters across sub-groups. Total sample was divided into eight sub-samples according to education (sub-sample with university education, sub-sample with elementary and second level of education), sex (female sub-sample, male sub-sample), age (sub-sample aged less than 30, sub-sample aged more than 30), income (sub-sample with income above than 3 500 € and sub-sample with income of 3 500 € or less) and household size (sub-sample with less than 3 members and sub-sample with more than 3 members). A preliminary step to analyze invariance across sub-groups is to consider a baseline model that it is estimated for each sub-sample. These models referred to as EDUCATION model, SEX model, AGE model, INCOME model and HOUSEHOLD model. Table 9 shows the fit of the simultaneously estimated models which provides the baseline value against which all subsequently specified models will be compared. Results show that the goodness of fit indexes for the multi-groups samples is well-fitting across the different sub-groups (Table 9).

Goodness of fit statistics related to the five constrained model are shown in Table 10. The χ^2 values provide the basis for comparison with the previously fitted models presented in Table 9. To test for the invariance of each constrained model, we compared the χ^2 values with that for the initial model in which no equality constraints were imposed. The results should be interpreted as follows. First, the EDUCATION model the χ^2 for the unrestricted model is $209.4_{(84)}$, the differences in χ^2 is 90.6 which is statistically significant. Second, the AGE model, the χ^2 for the unrestricted model is $166_{(84)}$, the difference in χ^2 between this value and the one for the restricted model is $9.3_{(87)}$, indicating that the null hypothesis of no difference between sub-groups can not be rejected. Then, for the HOUSEHOLD SIZE model, the value χ^2 is $326.9_{(84),}$ then, the difference in χ^2 between the models is $12.8_{(3)}$, indicating alto

Table 10. Goodness of fit statistics for tests of invariance

	Comparative model			
H0*: Structural weights constrained equal	χ^2	df	d(χ^2)	d(d.f)
EDUCATION model	300	87	**90.6**	3
SEX model	320.1	87	3.2	3
AGE model	175.3	87	**9.3**	3
INCOME model	367.5	132	8	6
HOUSEHOLD model	339.7	87	**12.8**	3

Note: *H0 means null hypothesis of no difference between sub-groups

Df = degrees of freedom; d(χ^2) = difference in χ^2 values between models; d(d.f) = difference in number of degrees of freedom between models

that the null hypothesis is not rejected. Finally, with respect to the SEX and INCOME, the difference in χ^2 show that the variables are not statistically significant. Then, based on these findings it can conclude that only difference between groups for EDUCATION, AGE and HAUSEHOLD variables has been found.

Hypotheses verification

The three first hypotheses are tested in the analysis of the pooled data (Figure 1) while hypothesis 5 has been tested as described above for the invariant pattern across sub-models.

Figure 1 shows that there is a positive casual relationship between NUTRITIONAL LABEL USE and HEALTHY EATING HABITS (0.50). Thus, we can conclude that the first hypothesis is verified. This means that consumers who have a higher use of nutritional labels are more likely to follow healthy eating habits. These results are in line with those reported by Guthrie et al. (1995); Teisl and Levy (1997); Variyam et al. (1996, 1998); Kim et al. (2000, 2001b) and Weaver and Finke (2003), linking nutritional information use with improvements in eating habits.

The positive estimate coefficient between the HEALTHY-DIET KNOWLEDGE and the NUTRITIONAL LABEL USE (0.20) supports the validity of the second hypothesis stated in the model. Thus, consumers who have a higher knowledge regarding health issues are more likely to use nutritional labels, in line with the results reported by Guthrie et al. (1995); Nayga (2000); Kim et al. (2001b); Drichoutis et al. (2005) and Gracia et al. (2007).

The positive estimate coefficients between FOOD_HEALTH and NUTRITIONAL LABEL USE (0.24), indicates that the fourth hypotheses has been verified. Thus, consumers more aware on the relationship between diet are more likely to use nutritional labels when choice food products. These results are in agreement with Shine et al. (1997);Wang et al. (1995); Kim et al. (2000, 2001a).

Finally, the results from the invariance analysis among sub-groups (Table 8 and) demonstrate that there are differences in heating habits behavior with regards to education level, age and, household size. This means that nutrition label use differ according to socio-demographic characteristics of individuals.

CONCLUSIONS

In recent years, changes in economic, social, cultural factors, as well as in tastes and consumers preferences are leading consumers to change their eating

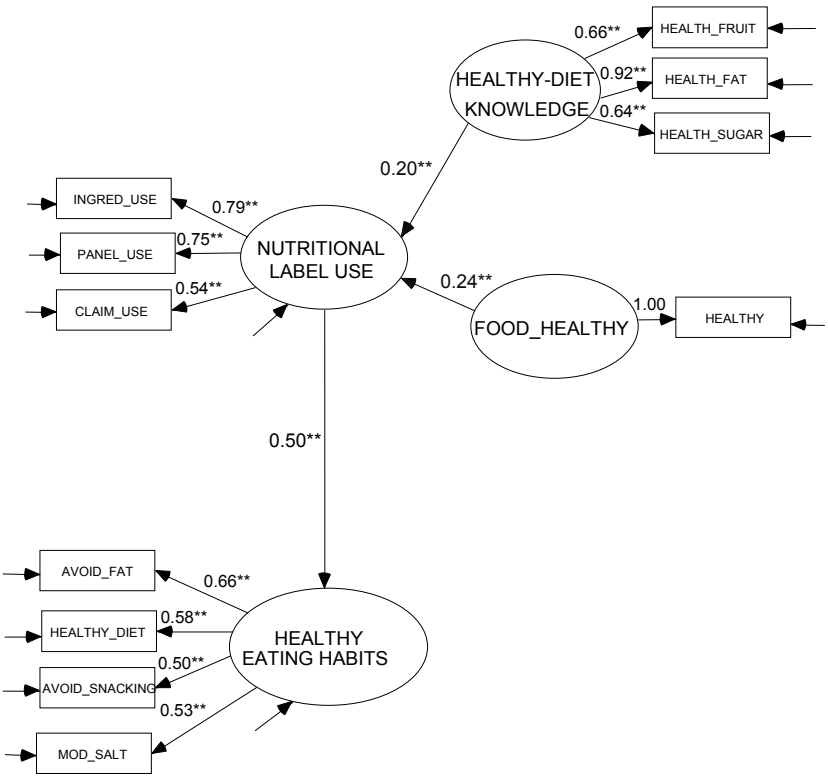

Figure 1. Path diagrams of the estimated model for pooled data

Note: Figures are standardised coefficients significant at the 0.05 significant level

habits. In developed countries, one of this changes is the increasing importance consumers are assigning to the diet-health relationship when making their food choices, as, the excessive fat and calories intake, scarce physical activity have lead to the increasing presence of overweight and the emergence of the cause the so-called diseases of the actual civilization such as diabetes, cardiovascular diseases or gout. These diseases limit the quality of life and increase health-related expenditures.

To reverse this trend different public health policies have been put in place in the EU among which nutritional labelling is one of the most prominent. This policy has made the legislative arena resulting in a common framework laying down the rules for foodstuffs labelling. The objective of legislation in the European Union is to guarantee that consumers have access to complete information on the content and composition of products, which in theory should lead to improved eating habits and in turn results in a better health status. However, these causal links need to be supported by evidence from the field, as the implementation of legislation only results in increasing access to information.

This paper has investigated the first of the two causal links, whether the use of nutritional labels influences on consumers' eating habits. Moreover, it has also provided additional evidence regarding those factors affecting on nutritional label use. The results indicate that, consumers who use nutritional labels follow healthier eating habits. This means that promoting the use of labels as the EU legislation foresees to do, can actually lead to a better diet. However, special attention should be paid to some socio-demographic variables which could limit the use of these labels. Further research is needed to see whether this is due to label design or these groups' culture and gastronomic traditions, as this would allow to design adequate policies for increasing label use by them. A second relevant finding is that the use of the nutritional label is independent from price attribute, which means that price is not acting as a barrier to nutritional label use by them.

According to these results, if the potential impact of food labelling legislation on eating habits is to be maximised, European, national and local policy makers should complement it with additional efforts in the field of education on nutrition and healthy eating habits. These would result in higher nutritional knowledge and/or higher consumer concerns about diet-health relationship. This in turn would expand nutritional label use which would lead to increased healthy eating habits in the population, and in the end and improved health status for Europeans.

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