International Food and Agribusiness Management Review
Volume 24, Issue 5, 2021; DOI: 10.22434/IFAMR2020.0162

Received: 15 September 2020 / Accepted: 30 December 2020

Understanding the low use rate of food nutrition information in China

RESEARCH ARTICLE

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Abstract

Based on a survey of 1,225 consumers in 10 cities of five representative provinces, this study was designed to understand the low use rate of food nutrition information in China after a mandatory label policy was instituted in 2013. We found that consumers always neglect nutrition information at point-of-purchase. But they refer to simplified front-of-pack labels more frequently than detailed back-of-pack labels. Fat information is most concerned especially by females; whereas sodium information attracts the least concern. Ignorance, a belief that the information is un-useful are the main cause of the low use rate of nutritional information. Thus, simplified and striking tag formats should be used to capture consumers' attention and convince them of the importance of nutrition information. The findings can also be used as a guide in the design of food marketing programs directing at different consumer groups for food processors targeting the Chinese market.

Keywords: nutritional information, label scheme, ignorance, attitudes, China
JEL code: I12, Q13, Q18

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1. Introduction

The consumption of processed foods is increasing rapidly in low-income and middle-income countries because they have enormous commercial advantages, including durability, palatability, immediate edibility (Popkin, 2014), and lower relative prices (Machado *et al.*, 2017). In China, the consumption of processed foods is increasing at a rate of 50% each year (Zhou *et al.*, 2015). In 2011, 28.5% of the total daily energy intake of Chinese adults came from processed foods, and this proportion was as high as 40.2% for children and teenagers in megacities (Zhou *et al.*, 2015). The growth of processed food has become one of the major reasons for the prevalence of overweight and obesity (Bonanno and Goetz, 2012; Louzada *et al.*, 2015) because processed foods are always associated with higher levels of saturated fats, sodium, added sugar, and energy, but are typically low in dietary fiber and micronutrients (Moubarac *et al.*, 2013). According to the Chinese Residents Nutrition and Chronic Disease Status Report (2015), the overweight rate in adults aged over 18 years throughout the country is 30.15% and the obesity rate is 11.9%, showing increases of 7.3 and 4.8%, respectively, since 2002. Considering absolute numbers, China has 43.2 million obese men and 46.4 million obese women becoming the country with the highest number of obese people worldwide due to the size of its population (NCD Risk Factor Collaboration, 2016).

Providing nutritional information on the package of foods is one of the most important measures taken by governments around the world to constrain obesity rates. Firstly, nutrition labeling is an essential instrument for reducing asymmetric and uncertain information by providing them with information on nutrient contents (Akerlof, 1970; Roe *et al.*, 2014). It increases consumers' confidence in the food market (Houghton *et al.*, 2008), and helps consumers especially those who are looking for special products to compare various foods (Lin *et al.*, 2014; Miller and Cassady, 2012). Secondly, nutrition labeling also influences the general perception of the health qualities of foods and reduces the attractiveness of unhealthy food (Boztuğ *et al.*, 2015). It can help consumers choose a healthier diet by reducing the intake of calories and fat (Shimokawa, 2016), and increasing the intake of fiber and vitamin (Grasso *et al.*, 2017).

In 2013, the Chinese government made it mandatory for food processors to disclose nutritional information on prepackaged foods by implementing the National Food Safety Standard for Prepackaged Food Labeling (GB 7718-2011). This aims to help consumers choose healthier foods by giving them access to consistent, easy-to-read, and trustworthy nutritional information. Under this regulation, Nutrition Facts Panels on the back of the package must display the amount of energy, protein, fats, carbohydrates, and sodium contained in a product in a standardized format, with their percentages relative to the nutrient reference value. And nutrition claims on the front of the package can only be displayed on the products which meet the specified criteria.

It is imperative that research be undertaken to understand the use of food nutritional information after this policy was instituted. However, few studies have focused on emerging countries such as China. Research conducted before the label policy by Liu *et al.* (2015) reported a low frequency of Nutrition Facts Panel label usage (28.5%) by Chinese consumers. In contrast, there has been considerable research into nutritional labeling in the USA and European countries (e.g. Grunert and Wills, 2007; Wang *et al.*, 2016). Generally, 40-60% of consumers in American and European countries are reported to use nutritional labels frequently, and most consumers are capable of understanding nutritional labels well.

Based on a nationwide sample of 1,225 Chinese consumers, this study was designed to understand the low use rate of food nutritional information in China after the mandatory label policy. To ensure a deep analysis, both detailed Nutrition Facts Panels and simplified Nutritional Claim labels, as well as five kinds of nutrients information including energy, protein, fat, carbohydrate, and sodium were considered. Two research questions were specifically addressed: (1) How often do Chinese consumers use different kinds of food nutritional information after the implementation of the mandatory labeling policy in 2013? (2) What factors explain the low use rate of nutritional information in China? For the remainder of the paper, we will first summarize the background of the food labeling policy in China. Then, the national survey data together with the analytical model are specified. This is followed by the results and discussion, and finally conclusion and implications.

2. Background of the food labeling policy in China

China's food labeling policy can be divided into three parts (Table 1). Firstly, food label policy provides general guidance on what should be labeled applying to all prepackaged food. China's first food label policy (GB 7718-1987) was published in 1987, then revised separately in 1994 and 2004. However, these regulations were all voluntary for general food enterprises, failing to get important consideration neither by food industries nor consumers. In 2011, the third amendment of the general food label standard (GB 7718-2011) modified the labeling methods of food additives, the specifications for the labeling method, and the contents of allergy-causing substances, making it first mandatory for all food enterprises.

Secondly, special dietary label policy standardizes the labeling of the energy and nutrient contents of special foods, including infant foods and nutrient-intensified foods, to meet the requirements of infants, ill individuals, and other special groups. China released the first special dietary label policy in 1992 (GB 13432-1992), then revised it and made it mandatory in 2004 (GB 13432-2004). It required the producers of prepackaged special dietary foods to include the contents of protein, fat, carbohydrate, and other nutrients and regulated the mode of presentation of and the allowable deviations from these energy and nutrients labeling requirements. Although only applied in special dietary products, GB 13432-2004 is the first mandatory labeling policy in China laying an important foundation for the follow-up mandatory policies.

Thirdly, nutrition label policy refers to the labeling related to the description of and facts about nutrient contents. Chinese first nutrition label policy was not formalized until 2007. It stated that energy, protein, fat, carbohydrate, and sodium contents should be described first in the Nutrition Facts Panels, together with any nutritional or functional claims. This regulation also specified a set of requirements for the label form, location, font, sequence, and so on. Then, in 2011, the Chinese first mandatory nutrition label policy was developed (GB 28050-2011), which came into effect in January 2013. Under this regulation, no prepackaged food can be sold unless it supplies the required nutrient content information. Furthermore, the precisely stipulated values corresponding to the nutrient contents must meet any nutritional claims, such as high calcium, low fat, and so on. This labeling standard marked a new stage in the standardization and regulation of label management in China. For the first time, it incorporated both nutrition and health in the overall food safety strategy.

Table 1. Development of food labeling policy in China.

Classification **Title of law or regulation (number or publication date)**	**Voluntary/ Mandatory**
Food label	
General standard for the labeling of foods (GB 7718-1987)	Voluntary
General standard for the labeling of foods (GB 7718-1994)	Voluntary
General standard for the labeling of prepackaged foods (GB 7718-2004)	Voluntary
National food safety standard for prepackaged food labeling (GB 7718-2011)	Mandatory
Special dietary label	
Labeling of foods for special nutrients (GB 13432-1992)	Voluntary
General standard for the labeling of prepackaged foods for special dietary uses (GB 13432-2004)	Mandatory
National food safety standard for prepackaged food labeling for special dietary uses (GB 13432-2013)	Mandatory
Nutrition label	
Food nutrition labeling management regulation (2007)	Voluntary
National food safety standard for prepackaged food nutrition labeling (GB 28050-2011)	Mandatory

3. Methods

3.1 National survey data

Data used in this study were obtained with nationwide face-to-face interviews undertaken in 2016. We used a multistage, random cluster process to randomly draw the sample surveyed from each province and city. We selected five provinces, Hebei, Guangdong, Zhejiang, Sichuan, and Hubei Province, representing the north, south, east, west, and middle of China, respectively. In each province, we randomly chose a developed and an underdeveloped city, according to the per capita gross domestic product in 2013 (China Statistical Yearbook, 2014). After a pretest was completed in Hangzhou, Zhejiang Province, the formal investigation was conducted from mid-July to mid-August 2016. The sample surveyed included individuals entering supermarkets or stores randomly chosen in each city. The participants all received ten yuan for their patience and time. Finally, a 1,225 Chinese resident sample was obtained, and the response rate is 96.46%.

The survey was found to have good validity and reliability. We measured the internal consistency separately for each section. Cronbach's α for each section was more than 0.7, greater than the minimum requirement for internal consistency recommended by Kline (1993). And the sample was roughly consistent with the China Statistics Yearbook (2015) in terms of age, marital status, and household size (Table 2). The respondents were aged 18-82 years, with an average age of 34.66 years. Of all the respondents, 60.66% were married, and the average household size was 3.57 family members. Males comprised 46.45% of the sample, which was slightly lower than the census data; but because women are the main shoppers in Chinese households, our sample is reasonable.

3.2 Empirical model

We assumed that a consumer's net utility from nutritional labels depends upon several attributes of the consumers and the food products. The net utility of label use is a function of vector X, which is composed of six attributes: demographic characteristics (x_1), habit-related variables (x_2), attitude to labeling (x_3), dietary habits (x_4), health status (x_5), and product factors (x_6). The empirical model is given by:

$$y^* = \beta' X_i + \varepsilon \quad (1)$$

Where y^* is the net utility of either: (a) back-of-pack Nutrition Facts Panel label; or (b) front-of-pack Nutrition Claim label; or (c) specific nutrient content in the Nutrition Facts Panel, including energy, protein, fat, carbohydrate, or sodium (Figure 1). As mentioned previously, X is a vector of the control variables, which include six distinct categories, defined in detail in Table 2. β is the parameter column vector; and ε is the random error term that allows for uncertainty.

Net utility y^* is a latent variable which we cannot observe directly. And Y_i is a random variable that indicates the observed frequency of nutritional label use by consumer i. For each type of label or nutrient, the respondents were asked: 'In general, how often do you look for this information on a food package while shopping', with a five-point answering scale: 1 = always, 2 = often, 3 = sometimes, 4 = seldom, and 5 =

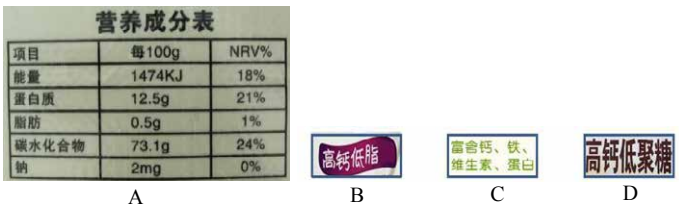

Figure 1. Nutrition Facts Panel (A) and Nutrition Claims (B, C, D) in China.

Table 2. Statistical analysis and definitions of independent variables.

Variable	Definition	Mean	Country level[1]
Demographic characteristics (x_1)			
AGE	Self-reported age (continuous from 18 to 70)	34.66	37.00
MALE	Male=1, 0 otherwise	0.46	0.51
EDU (%)	Primary school or below	2.42	31.62
	Junior high school	14.46	40.15
	Senior high school	26.17	16.70
	Junior college or above	56.95	11.53
POPU	The number of people living together	3.57	3.00
HINCO	Log of household income (10,000 yuan)	2.36	
WORK	Respondent is employed=1, 0 otherwise	0.88	
KID	The number of children under 3 years old	0.20	
OLD	The number of people aged over 60 years	0.73	
NKI	Objective nutrition knowledge index (continuous from 0 to 5)	2.94	
Habit-related variables (x_2)			
TONIC	If take supplements=1, 0 otherwise	0.32	
SMOK	The frequency of smoking (from 1=never to 6=two bags a day)	1.49	
EXER	The frequency of exercise (from 1=never to 6=every day)	3.03	
FREQ	The frequency of shopping (from 1=never to 5=always)	3.09	
TIME	Perceived time pressure while shopping (from 1=very liberal to 5=very pressed)	2.53	
Attitudes to labeling (x_3)			
IGNOR	Rarely notice Nutrition labels[3]	2.91 (2.61)[2]	
ATTI	Nutrition labels are un-useful (discrete from 0 to 10)	5.86 (5.42)	
SKEP	Skepticism of the content of nutrition labels (discrete from 0 to 10)	6.42 (6.40)	
OBUND	Objective understanding level on labels (continuous from 0 to 3)	0.97	
UNDER	Subjective understanding level on labels[3]	3.04 (3.30)	
CBUY	Preference for Nutrition Claims (-1,0,1)	0.73	
Dietary habits (x_4)			
VEGE	Vegetarian=1, 0 otherwise	0.21	
SLIM	Be on a diet=1, 0 otherwise	0.27	
NOFAT	Try to cut back on fatty foods[3]	3.33	
SNAC	Cannot help eating sweets or snacks[3]	2.56	
NONA	Always limit the intake of salt[3]	3.18	
VITAM	Pay attention to the intake of vitamins[3]	3.07	
Health status (x_5)			
DISE	Suffer from diet-related diseases=1, 0 otherwise	0.38	
RELA	Views on the relation between diet and disease[4]	4.31	
SUBFAT	Think themselves overweight or obese=1, 0 otherwise	0.44	
OWEI	Overweight (24≤ BMI <28) =1, 0 otherwise	0.23	
OBES	Obese (BMI ≥28) =1, 0 otherwise	0.04	
Product factors (x_6)			
NUTR	The importance of nutrition while shopping[4]	3.93	
PRIC	The importance of price while shopping[4]	3.41	
TAST	The importance of taste while shopping[4]	3.98	
BRAD	The importance of brand while shopping[4]	3.70	

[1] Country-level data are from the China Statistics Yearbook, 2015.

[2] Values outside the brackets are the means of Nutrition Facts Panel-related variables. Values within brackets are the means of Nutrition Claim-related variables.

[3] Measured by 5 levels Likert scale from 1 (absolutely disagree) to 5 (absolutely agree).

[4] Measured by 5 levels Likert scale from 1 (not important at all) to 5 (very important).

never. Traditionally, β can be estimated from the ordered logit model because the frequencies are ranked in order (Long, 1997). However, an important assumption for ordinal logistic regression models is the parallel lines assumption, that the parameters do not change for different categories. As shown in Table 3, five kinds of tests were used to test the parallel lines assumption (Long, 1997). Because the assumption did not hold in all of the tests (all *P*-values <0.01), we estimated partial proportional odds models (PPOM), as suggested by Peterson and Harrell (1990), instead of the ordered logit model (Williams, 2006).

A key advantage of PPOM is that it allows some of the coefficients in β to be the same for all values of j in the following equation, while others can differ. If we assume that the random error term ε follows a logistic distribution, with a mean of 0 and a variance of $\pi^2/3$, then the cumulative probability equation for PPOM can be written as:

$$P(Y_i \le j) = \frac{exp(\mu_j - \beta_j' X_i)}{1+[exp(\mu_j - \beta_j' X_i)]} = \Lambda(\mu_j - \beta_j' X_i) \quad , j = 1,2,3,4 \tag{2}$$

j = 1,2,3,4, represents the changes in consumers' nutrition label usage frequency, from never to seldom, from seldom to sometimes, from sometimes to often, from often to always respectively. The probabilities of Y_i can be expressed as:

$$P(Y_i=1) = \Lambda(\mu_1 - \beta_1 'X_i) \tag{3}$$

$$P(Y_i=2) = \Lambda(\mu_2 - \beta_2 'X_i) - \Lambda(\mu_1 - \beta_1 'X_i) \tag{4}$$

$$P(Y_i=3) = \Lambda(\mu_3 - \beta_3 'X_i) - \Lambda(\mu_2 - \beta_2 'X_i) \tag{5}$$

$$P(Y_i=4) = \Lambda(\mu_4 - \beta_4 'X_i) - \Lambda(\mu_3 - \beta_3 'X_i) \tag{6}$$

$$P(Y_i=5) = 1 - \Lambda(\mu_4 - \beta_4 'X_i) \tag{7}$$

The log-likelihood function can be written as:

$$\begin{aligned} LnL = \sum_{i=1}^{n} \{ & P(Y_i=1)\, ln\Lambda(\mu_1 - \beta_1 'X_i) + P(Y_i=2)\, ln[\Lambda(\mu_2 - \beta_2 'X_i) - \Lambda(\mu_1 - \beta_1 'X_i)] + \\ & P(Y_i=3)\, ln[\Lambda(\mu_3 - \beta_3 'X_i) - \Lambda(\mu_2 - \beta_2 'X_i)] + \\ & P(Y_i=4)\, ln[\Lambda(\mu_4 - \beta_4 'X_i) - \Lambda(\mu_3 - \beta_3 'X_i)] + P(Y_i=5)\, ln[1-\Lambda(\mu_4 - \beta_4 'X_i)]\} \end{aligned} \tag{8}$$

The unknown parameters μ_1, μ_2, μ_3, μ_4, and the parameter vector β can be estimated simultaneously with the maximum likelihood method.

3.3 Endogeneity tests

Some variables in this study such as objective nutrition knowledge may be endogenous. Over time, a consumer reads more and more nutrition labels, and this allows him/her to compare the various nutrients between different foods. Therefore, nutrition knowledge may increase with more-frequent label use. Thus, we tested

Table 3. Tests of the parallel regression assumption.

Methods	**Chi^2**	**df**	***P*>Chi^2**
Wolfe Gould	142.8	102	0.005
Brant	139.4	102	0.008
Score	155.9	102	0.000
Likelihood ratio	157.7	102	0.000
Wald	162.2	102	0.000

for the endogeneity of objective nutrition knowledge using Hausman's specification test (Hausman, 1978) and the Durban-Wu-Hausman (DWH) test (Davidson and MacKinnon, 1993). The results of all endogeneity tests did not reject the null hypothesis, indicating that endogeneity was not an important problem in this study (Table 4).

The results may be explained by the following two aspects of current China. First, Chinese consumers' usage rate of nutrition labels is much lower than that in developed countries; and they understand and remember the nutrition information on the labels poorly (Liu *et al.*, 2015). Therefore, it is difficult for Chinese consumers to acquire nutrition knowledge or change diet habits according to label information. Second, no mandatory Chinese labeling policy was instituted until January 2013. Besides, there has been no national or regional education campaign to explain the meanings of nutrition labels or to promote nutrition labeling until now which contributes little to consumers' individual characteristics such as nutrition knowledge. In conclusion, endogeneity did not severely affect this sample, and Chinese consumers, therefore, constitute a useful population in which to directly assess the effects of various variables including nutrition knowledge on label use.

4. Findings and discussion

4.1 Use of two kinds of nutrition labels

For two kinds of nutrition labels, the respondents paid more attention to simplified Nutrition Claims than detailed Nutrition Facts Panels. Specifically, only 17.45 and 4.52% of respondents stated that they often or always used Nutrition Facts Panels when shopping. The situation in China is in sharp contrast to those in America and Europe, where 40-60% of adults frequently used nutritional labels (e.g. Boztuğ *et al.*, 2015; Sun *et al.*, 2015;). In another Asian country, Korea, more than 34% of shoppers were frequent users (Kim *et al.*, 2016). Our results are even lower than those in previous studies conducted in China before the mandatory labeling policy was instituted (e.g. Liu *et al.*, 2015), which showed that 28.7% of consumers often or always use Nutrition Facts Panels. This discrepancy may have arisen because we used a nationwide sample in our study, whereas the data in the previous studies were collected in only one or two cities in China. For simplified Nutrition Claims, about 41.20% of respondents often or always use Nutrition Claims, twice the proportion who frequently used Nutrition Facts Panels. This was not simply because the Nutrition Claims are much easier to understand, but also because they are more strongly highlighted on the fronts of the packages than the Nutrition Facts Panels on the backs of the packages. Front-of-package label with simplified information or displayed using colors and pictures makes nutrition information more available and increases consumers' attention (Aschemann-Witzel *et al.*, 2013). It can also help consumers better understand the label content and choose a healthier diet (Khandpur *et al.*, 2017).

4.2 Use of five nutrients in Nutrition Facts Panels

Of the five different nutrient contents presented on the Nutrition Facts Panels, the consumers were most concerned about fat, where 35.78% of consumers reported frequently use fat information. This is possibly because fat is a kind of negative information. It has been reported by Burton *et al.* (1999) that negative information, such as fat content, attracts more attention than positive information, such as vitamin content. This finding indicates that consumers are more motivated to avoid the undesirable consequences of negative nutrients than to enjoy the benefits of positive nutrients. However, sodium, another nutrient presented as

Table 4. Endogeneity tests for nutrition knowledge.

Models	Hausman test: χ^2	Durban-Wu-Hausman test: χ^2
Nutrition Knowledge Index – Nutrition Facts Panel	0.42 (P=0.52)	0.44 (P=0.51)
Nutrition Knowledge Index – Nutrition Claim	1.39 (P=0.24)	1.47 (P=0.22)

negative information, attracted the least concern of Chinese consumers. Only 15.99% of consumers reported that they often or always used sodium information. According to Wang *et al.* (2011), the Chinese consume over 12 g of sodium per person per day, twice the maximum intake recommended by the World Health Organization. But Chinese consumers rarely attend to sodium information on the nutrition labels. This is possibly because the sodium information occurs at the bottom of the Nutrition Facts Panel, where it is easily ignored.

4.3 Factors affecting the use of Nutrition Facts Panels and Nutrition Claims

Table 5 summarizes the results of the partial proportional odds regression models, using the frequencies of Nutrition Facts Panel use and Nutrition Claims use as the dependent variables. The pseudo-R^2 values for both equations were about 0.20, indicating that the estimated equations respectably fit the survey data.

Of the demographic factors examined, EDU (the level of education) played a positive role to increase consumers' use frequency of Nutrition Facts Panels from often to always, but has no significant impact at low-frequency use levels. Possible explanations for this result are that respondents with higher education level may be more concerned about health and nutrition, and also more literate, allowing them to comprehend Nutrition Facts Panels, which are more complex than Nutrition Claims (Lin and Yen, 2008; Moore *et al.*, 2018). Interestingly, HINCO (household income) was negatively associated with the use of Nutrition Facts Panels, demonstrating that respondents from the higher-income household are less likely to use Nutrition Facts Panels. This is possibly because the higher household income group can buy more-expensive foods and is always confident of the nutritional and health status of these foods (Drichoutis, 2005). Unfortunately, NKI (objective nutrition knowledge) had no significant effect on Nutrition Facts Panel use. However, the significant positive effects of NKI on the use of Nutrition Claims showed that nutrition knowledge can help to promote the use rate of simplified Nutrition Claims. Although Nutrition Facts Panels are more complex and require more knowledge to understand than Nutrition Claims, it is placed on the back of the package and rarely attended to in the consumers' decision process (Peschel *et al.*, 2019). Our results confirm that Chinese consumers with greater knowledge of nutrition are more likely to use simplified front-of-pack labels, but not back-of-back labels with detailed information.

Of the habit-related factors, respondents who shopped more frequently (FREQ) tended to use both kinds of nutrition labels more frequently possibly because they are more familiar with nutritional labels. And familiarity is a key factor in information processing and label use (Grunert and Wills, 2007). The estimates of EXER (the frequency of exercise) and TONIC (the use of health supplements) were consistent and positive but were only statistically significant for Nutrition Facts Panels. These results indicate that respondents who participated in physical exercise or took supplements used Nutrition Facts Panels more frequently, partly because they were more health-conscious (Rimal *et al.*, 2000). Although related research (e.g. Drichoutis, 2005) has reported that respondents with greater time pressure are less likely to read nutritional labels in developed countries, we found no statistically significant effect of TIME indicating that time pressure is not an important factor on label use in China.

Attitudes to labeling were identified as important causes of the low use of nutritional labels in China. The negative estimates for IGNOR (rarely notice labels) and ATTI (the belief that these labels are un-useful) indicated that the respondents who were unaware of nutritional labels on the food packages or who regarded the labels as useless were less likely to use either Nutrition Facts Panels or Nutrition Claims. Chinese consumers consider nutritional labels virtually useless because they find labels too hard to interpret or do not know how to use nutritional information to make a decision. However, SKEP (skeptical attitudes towards the accuracy of the label content) did not play a significant role in their use. This is inconsistent with the findings of Sun *et al.* (2015), who reported that consumers' trust in and ethical evaluation of the honesty of statements made by companies affected their search for nutritional information. This may be possibly because most Chinese consumers have confidence in the scientific basis of nutritional labels in this survey. UNDER (subjective understanding) was significantly positive in increasing the use frequency of Nutrition Facts Panels from

Table 5. Marginal effects for the use of nutrition facts panels and nutrition claims.[1]

Variable	Nutrition facts panels				Nutrition claims			
	1[2]	2	3	4	1	2	3	4
AGE	-0.01	-0.01	-0.01	-0.01	0.01	0.01	0.01	0.01
MALE	-0.45	0.09	-0.25	0.10	-0.25	-0.25	-0.25	-0.25
EDU	1.31	0.28	0.14	0.81***	0.32	0.32	0.32	0.32
POPU	0.05	0.05	0.05	0.05	-0.04	-0.04	-0.04	-0.04
HINCO	-0.18*	-0.18*	-0.18*	-0.18*	-0.02	-0.02	-0.02	-0.02
WORK	-0.70	0.40	-1.13**	-0.26	0.37	0.37	0.37	0.37
KID	-0.21	-0.21	-0.21	-0.21	0.37	-0.38*	-0.16	0.34
OLD	0.15	-0.06	0.06	0.27**	-0.01	-0.01	-0.01	-0.01
NKI	0.09	0.09	0.09	0.09	0.35***	0.35***	0.35***	0.35***
TONIC	0.25*	0.25*	0.25*	0.25*	0.17	0.17	0.17	0.17
SMOK	0.10	0.10	0.10	0.10	0.07	0.12	0.00	-0.16
EXER	0.40**	0.40**	0.40**	0.40**	0.21	0.21	0.21	0.21
FREQ	0.30***	0.30***	0.30***	0.30***	0.28***	0.28***	0.28***	0.28***
TIME	-0.05	-0.05	-0.05	-0.05	-0.02	-0.02	-0.02	-0.02
CBUY	–	–	–	–	-0.20	0.33*	0.62***	1.27***
IGNOR	-0.42***	-0.42***	-0.42***	-0.42***	-0.38**	-0.66***	-0.57***	-0.31**
ATTI	-0.21***	-0.21***	-0.21***	-0.21***	-0.02	-0.14***	-0.13**	-0.28***
SKEP	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
OBUND	0.01	0.01	0.01	0.01	0.31*	0.07	-0.13	0.14
UNDER	0.29*	0.18*	0.01	0.13	-0.03	-0.03	-0.03	-0.03
VEGE	0.14	0.14	0.14	0.14	0.15	0.50**	0.34	-0.41
SLIM	-0.46**	-0.46**	-0.46**	-0.46**	0.25	-0.11	0.04	-0.86**
NOFAT	0.08	0.08	0.08	0.08	0.33**	0.01	0.03	0.07
SNAC	0.00	0.00	0.00	0.00	0.06	0.06	0.06	0.06
NONA	0.32*	0.21**	0.12*	-0.06	0.06	0.06	0.06	0.06
VITAM	0.10	0.10	0.10	0.10	0.44***	0.22***	0.03	0.08
DISE	0.08	0.08	0.08	0.08	0.06	0.06	0.06	0.06
RELA	0.20	0.23	-0.04	0.28*	0.12	0.12	0.12	0.12
SUBFAT	0.26	0.26	0.26	0.26	-0.02	-0.02	-0.02	-0.02
OWEI	0.01	0.01	0.01	0.01	0.13	0.13	0.13	0.13
OBES	-0.77*	-0.77*	-0.77*	-0.77*	-0.51	-0.51	-0.51	-0.51
NUTR	2.48**	0.84	0.45	-0.35	0.49	0.49	0.49	0.49
PRIC	-0.38	-0.38	-0.38	-0.38	0.14	0.14	0.14	0.14
TAST	-0.09	-0.09	-0.09	-0.09	-0.08	-0.08	-0.08	-0.08
BRAD	0.77	-0.47	-0.20	-0.71**	0.07	0.07	0.07	0.07
Region	Yes				Yes			
_cons	9.44***	4.87***	-1.47	-1.39	9.56***	3.36***	1.02	-0.36
Pseudo R^2	0.1951				0.2055			
χ^2	696.67				718.13			
$P>\chi^2$	0.0000				0.0000			
N	1,225				1,225			

[1] * $P<0.05$, ** $P<0.01$, *** $P<0.001$.

[2] 1,2,3,4, represents the changes in consumers' nutrition label usage frequency, from never to seldom, from seldom to sometimes, from sometimes to often, from often to always respectively.

never to seldom and from seldom to sometimes. However, OBUND (objective understanding) did not affect Nutrition Facts Panel use. These results indicate that if low-frequency users consider themselves capable of comprehending nutritional labels, they were more likely to read Nutrition Facts Panels, whereas those who can understand the labels did not witness greater interest in referring to Nutrition Facts Panels for more information. Our results are supported by Liu *et al.* (2015) and expose a profound dissonance in China between the ability to comprehend nutritional information and seeking such information. A possible explanation is that many Chinese consumers regard reading nutritional labels as un-useful or time-consuming. As shown in this survey, 33.06% of the consumers reported that reading nutritional labels is un-useful; whereas 44.73% of the consumers regarded nutrition labels as a useful tool.

In terms of dietary habits, the respondents who always limited their intake of salt (NONA) were more likely to read Nutrition Facts Panels. Unfortunately, people who were struggling to lose weight (SLIM) used Nutrition Facts Panels less frequently than other respondents, indicating that nutritional information is typically ignored or underutilized by dieters. In contrast, consumers in Europe or America are more likely to use nutrition information if they keep on a special diet (Kim *et al.*, 2000; Unnevehr and Jagmanaite, 2008). Respondents who paid special attention to their intake of vitamins (VITAM) were more inclined to read Nutrition Claims from never to seldom and from seldom to sometimes, possibly because information about vitamins regularly appears in claim labels.

Among the health status factors, only OBES (obesity) correlated significantly but negatively with the use of Nutrition Facts Panels. This indicates that respondents who were obese in our sample were less motivated to use Nutrition Facts Panels than normal-weight respondents. In comparison, overweight or obese people in Europe and America tend to use nutrition labels more frequently (Blitstein and Evans, 2006; Drichoutis *et al.*, 2008). A possible explanation for underutilizing nutrition labels by obese Chinese people is that they attach more importance to taste, and less importance to nutrition.

Product attribute factors had little effect in our study. The NUTR (nutritional characteristics of a product) had a positive effect on the use of Nutrition Facts Panels from never to seldom, indicating that those who never used Nutrition Facts Panels but attached importance to nutrition tend to increase use frequency of Nutrition Facts Panels from never to seldom. The BRAD (importance of brand) had a negative sign on the use of Nutrition Facts Panels from often to always, implying that frequent users who value products brand as important are less likely to use Nutrition Facts Panel, which is consistent with many previous studies (e.g. Barreiro-Hurlé *et al.*, 2010; Verbeke, 2006). This is possibly because a brand is an indicator of quality for many brand loyalists. Therefore, they only choose their trusted brands, rather than consulting label information.

4.4 Factors affecting the use of nutrient information

This paper also summarizes the results of the partial proportional odds regression models in which the use frequencies of information on the five nutrients on the Nutrition Facts Panels are the dependent variables (Supplementary Tables S1-S3). The pseudo-R^2 values for the five models were between 0.11 and 0.15, which implies that the estimated equations are reliable.

IGNOR and ATTI had statistically significant negative coefficients for all five nutrients. Again, our results identified ignorance of labeling and an attitude that this information was un-useful as the most important factors explaining the low use of various types of nutritional information in China. FREQ (shopping frequency) was positively associated with the use of information on energy, protein, fat, and carbohydrate, demonstrating that Chinese consumers who shopped more often used the information on these nutrients more frequently, although this was not true for Sodium. This may be attributable to the fact that information on sodium was widely neglected by Chinese consumers, no matter how often they shopped for foods.

Demographic factors played a more significant role in the energy information usage. Although insignificant effects were found in the Nutrition Facts Panel model, the coefficients for AGE (self-reported age) were

significantly negative in the energy equation, indicating that elderly people were less likely to read energy information. This is possibly because elderly people attend nutrition facts panel labels but they have difficulty in understanding the nutrient content information in it. Thus, the use frequency of nutrition facts panel label between consumers of different ages is similar, but elderly people got less energy information from it. However, respondents with jobs (WORK) were more attentive to energy information when they read Nutrition Facts Panel labels, possibly because they are more energy-consuming than non-workers. Unlike the Nutrition Facts Panel model, NKI, SMOK (frequency of smoking), OBUND (objective understanding of nutrition labels), and VITAM were all positively significant in the use of the energy information. These results show that nutritional knowledge and understanding ability can help to read energy information. Respondents who smoked habitually were more likely to read energy information than nonsmokers, which is inconsistent with previous studies (e.g. Drichoutis *et al.*, 2009). A possible explanation is that smokers in China are aware of the dangers of smoking but do not want to quit. Therefore, other health-inducing measures, such as attention to nutrients content information, are taken to compensate for the risk conferred by smoking.

Dietary habits and product factors were identified as important explanations of protein information use. The significantly positive estimates for VEGE (vegetarians) and NONA (those who restrict their salt intake) indicate that vegetarians and those who limit their intake of salt are more inclined than others to read protein labels. This is possibly because the diet of vegetarians, which contains no meat, lacks sufficient protein, so these people may be more health-conscious than nonvegetarians. The significant coefficient of TAST implies a negative relationship between taste and the use of protein labels, indicating that consumers who rate taste as important are less interested in the protein content of foods.

In terms of the use of fat information, MALE was negatively significant, indicating that males are less interested in reading fat labels than females. The positive estimate of NOFAT (the preference for reduced-fat foods) variable showed that respondents who avoided fat paid special attention to fat labels. The sign of RELA (perception of the relationship between diet and disease) was positive, indicating that people who attach importance to the relationship between diet and disease were more likely to read fat labels. This may be partly explained by the fact that fat is a kind of negative information among the five nutrients cited on labels and is closely related to overweight and obesity, as well as to many chronic diseases.

Concerning the carbohydrate and sodium equations, the sign of TONIC was significantly positive, indicating that the custom of taking supplements promotes the use of both nutrients. Respondents with larger households (POPU) were more likely to use sodium labels. This is possibly because when families are large, the likelihood that members have special dietary habits or diseases related to excessive salt intake increases. Furthermore, in multi-person households, the benefits of label use extend to more people, and the relative value of the time spent in obtaining information on sodium increases.

5. Conclusions and implications

The consumption of processed foods is growing rapidly all over the world and is widely considered a major cause of the prevalence of overweight and obesity. Nutritional labels, such as back-of-pack Nutrition Facts Panel and front-of-pack Nutrition Claims, are always considered the best available tool to help consumers choose healthier diets. Since 2013, the Chinese Government has made it mandatory for food processors to disclose the nutritional characteristics of prepackaged foods. Using a nationwide sample of 1,225 individuals, this study was designed to understand the situation and causes of the low use rate of nutritional information after the mandatary labeling policy in China.

Firstly, this study displayed the low use rate of food nutrition information in China, but consumers prefer simplified front-of-pack nutrition claims more than detailed back-of-pack nutrition facts panels. When assessed the use of information on the five main nutrients, we found that the most frequently used information was on fat, but information on sodium is widely neglected. Secondly, we found that ignorance and the attitude that labels are not useful were the main factors explaining the low use rate of all kinds of nutritional information

in China. Chinese consumers ignore food labels, especially Nutrition Facts Panels because the content is complex and the labels are placed unobtrusively on the back of the packet. The poor location in the nutrition facts decreases its relevance and interest for consultation by consumers, and that frontal nutrition labeling could contribute to improving visibility. Besides, subjective understanding helps use the Nutrition Facts Panels, whereas objective understanding plays a significant role in the use of energy and protein information. Thus, the education program should be launched to improve both consumers' understanding ability and their subjective confidence in utilizing nutrition labels.

Our findings will have several implications in the design of nutrition labels especially for food processors targeting the Chinese market. First, food processors should use more simplified and striking tag formats, including Nutrition Claims and other front-of-pack labels, to improve consumer welfare and advertise product features. Brighter colors or larger fonts should also be considered by the food processors to highlight nutritional information statements. Second, sodium information can be emphasized when designing labels. 'Salt' may be used as a replacement of 'sodium' or 'Na' in the present nutrition labels. Because in this survey Chinese consumers reported that they are unfamiliar with the technical term 'Na' or 'sodium'. The order of display of nutrients in Nutrition Facts Panels should also be adjusted, such as placing sodium information first, so that it draws the attention of Chinese consumers.

These findings can also be used as a guide for food processors in the design of food marketing programs to advertise and promote directing at different consumer groups. In the first place, simplified front-of-pack labels should be emphasized especially for elderly people. Detailed back-of-pack labels can be applied when targeting people with a larger household size or higher education. Second, food advertising campaigns designed for different age and gender groups can be more effective. For example, stress on fat information targeting younger females but protein information targeting younger males. Finally, agribusiness firms could also considerably benefit from investing in nutrition campaigns in terms of their public image as they will contribute to more widespread adoption of healthy food selection.

Supplementary material

Supplementary material can be found online at https://doi.org/10.22434/IFAMR2020.0162

Table S1. Marginal effects for the use of energy and protein information.
Table S2. Marginal effects for the use of fat and carbohydrate information.
Table S3. Marginal effects for the use of sodium information.

Acknowledgements

The authors would like to thank research assistants Yue Jin, Changhua Qian, Haiyue Guo, Rao Yuan, Zhanyi Shi, Yu Jiang for their helpful support in data collection. We also gratefully acknowledge the funding support from the National Natural Science Foundation of China (grant number 72003175), the Major Program of the Key Research Institute of Chinese Ministry of Education (grant number No. 15JJD790032), and the Scientific Research Project of Zhejiang Education Department (grant number Y202043173). The authors have declared that no conflict of interest exists.

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