



Association between Nutrition Label Use and Chronic Disease in Korean Adults: The Fourth Korea National Health and Nutrition Examination Survey 2008-2009

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Nutrition labels are helpful for chronic disease management in patients requiring balanced nutritional intake. This study aimed to investigate the association between the use of nutrition labels and chronic diseases (hypertension, diabetes mellitus, and hyperlipidemia) by using the 2008-2009 Korea National Health and Nutrition Examination Survey data. A total of 10,695 individuals aged 20 and over was included in the analysis. Using multiple logistic regressions, there was no difference in nutrition label use between the chronic disease and normal groups (men with hypertension OR, 0.97; 95% CI, 0.75-1.27; women with hypertension OR, 0.83; 95% CI, 0.67-1.03; men with diabetes OR, 0.70; 95% CI, 0.45-1.08; women with diabetes OR, 1.13; 95% CI, 0.84-1.53; men with hyperlipidemia OR, 0.85; 95% CI, 0.59-1.23; women with hyperlipidemia OR, 1.14; 95% CI, 0.91-1.44). In hyperlipidemia patients, awareness (OR, 1.55; 95% CI, 1.03-2.35) and control (OR, 2.19; 95% CI, 2.32-3.63) of disease were related to nutrition label use; however, no significant associations were found for the hypertension and diabetes mellitus patients. Considering the importance of dietary habits in the management of chronic diseases, an improvement in nutrition label use by patients with these diseases is required.

Keywords: Nutrition Labeling; Chronic Disease

INTRODUCTION

The incidence of chronic diseases such as diabetes mellitus, hyperlipidemia, and hypertension is increasing worldwide. The prevention and management of these diseases has become an important public health issue in Korea (1, 2). Several studies have shown an association between dietary habits and the development and progression of chronic disease (3-5). Furthermore, many treatment guidelines emphasize the importance of a healthy diet for the prevention and management of these diseases (6, 7). As such, appropriate nutrition is an important aspect of public health (8).

Globally, many countries have introduced policies to modify nutrition intake of the public. Of these, nutrition labels help consumers to modify their nutrition intake by providing the nutritional values or ingredient contents of the products that they purchase (8, 9). The United States introduced nutrition labeling in the 1990s, and this is currently a mandatory component of all processed foods (10). Recently, the US Food and Drug Administration (FDA) proposed an update to the nutrition label to reflect the latest research on chronic disease and nutrition (11). Canada introduced voluntary nutrition labeling in 1988, which became mandatory in 2003 (8). In 1993, the US FDA predicted

that the introduction of mandatory nutrition labeling could prevent 39,200 cardiovascular disease and cancer cases and 12,902 deaths for 20 yr (12). Korea introduced nutrition labeling in 1994. Since then, various processed food products have been designated for nutrition labeling (13).

Nutrition labeling can provide chronic disease patients, who wish to maintain a healthy diet, with specific information about the food products they consume. A study using data from the US National Health and Nutrition Examination Survey (NHANES) reported that chronic disease patients who had received nutrition education were 50% more likely to read nutrition labels. Furthermore, those who read nutrition labels tended to consume less calories, saturated fatty acids, and carbohydrates (14). A study using data from the Korea National Health and Nutrition Examination Survey (KNHANES) showed that consumers who use nutrition labeling had a lower risk of developing metabolic syndromes (15).

Chronic disease patients should actively use nutrition labels; however, limited studies have investigated the use of nutrition labels and its associated factors in patients with chronic diseases. Several studies reported that chronic disease patients use nutrition labels more frequently than healthy persons (16, 17); however, a study showed no association between nutrition la-

bel use and diabetes mellitus among Latino Americans (18). Several studies analyzed the effect of various factors on the use of nutrition labels and the perception of nutrition labels in consumers (19-21); however, to the best of our knowledge, no study has investigated the use of nutrition labels by chronic disease patients in Korea. Therefore, the aim of this study was to investigate the association between the use of nutrition labels and chronic diseases in adult Koreans.

MATERIALS AND METHODS

Study participants

Data were collected from the fourth KNHANES, which is a national project that investigates the health status, health awareness and actions, and food and nutritional intake of all households and citizens living in the Republic of Korea. The survey, based on the Population and Housing Census Report conducted by the National Statistical Office in 2005, selected and interviewed household members aged 1 yr and above from approximately 13,800 households in 600 districts. The samples were selected using a 3-step stratified cluster sampling method. The Rolling Survey Sample method was used so that each rolling sample of a year represents a probability sample of the country. The rolling samples were made to be independent and homogeneous. Health surveys and examinations were performed in a mobile health examination center, and the nutrition surveys were performed by visiting the households.

In total 20,277 people completed the survey and health examination. Excluded from analysis were 5,371 people who were under the age of 20 yr, 3,404 people who did not answer questions on history of chronic disease and the use of nutrition labels, and 807 people who had a history of stroke, myocardial infarction, angina, and cancer. The final study population consisted of 10,695 participants.

Variables associated with chronic disease and the use of nutrition labels

Hypertension was defined as having a systolic blood pressure of ≥ 140 mmHg or a diastolic blood pressure of ≥ 90 mmHg (measured in the arm at the heart level), or taking antihypertensive medications at the time of the study. Diabetes was defined as having fasting glucose concentration of ≥ 126 mg/dL or as taking diabetic medications at the time of the study. Hyperlipidemia was defined as having total cholesterol of ≥ 240 mg/dL or as taking hyperlipidemia medications at the time of the study. Those who answered that they had been diagnosed by a medical professional with one or more chronic diseases were defined as having an awareness of these diseases. Participants that were considered in control of their chronic disease were defined as having a systolic blood pressure < 140 mmHg or a diastolic blood pressure < 90 mmHg for hypertension; a

HbA1c level of $\leq 6.5\%$ for diabetes; or a total cholesterol concentration ≤ 200 mg/dL for hyperlipidemia. For the use of nutrition labels, the question "Do you read the nutrition label when buying or choosing processed foods?" was asked. Those who answered "I do not know what a nutrition label is" or "I do not read nutrition labels" were classified as those who did not use the nutrition label, whereas those who answered "I do read nutrition labels" were classified into the group that read the nutrition labels.

Socio-demographic variables

A trained investigator conducted interviews to collect the participants' socio-demographic data, from which variables were selected that were closely associated with nutrition labels using previous studies as references (14, 22). The final variables selected were age, gender, household income, number of household members (1, 2, 3, or 4 or more persons), marital status (single, separated or divorced, married), duration of education (6 yr or under, 7 to 12 yr, 13 yr or more), obesity, smoking status (non-smoker, ex-smoker, current smoker), and the frequency of alcohol intake (non-drinker, once a week or less, at least twice per week). Those who answered "yes" to the question "Have you received nutrition education or consultation from a public health center, government office, social welfare facility, school, or hospital in the past 12 months?" were classified as having received nutrition education.

Statistical analyses

In order to represent all Korean adults without biased estimates, sampling weights were applied to account for the complex sampling. The chi-square test and *t*-test were conducted to investigate the general characteristics of the participants depending on nutrition label use. The Mantel-Haenszel homogeneity method was used to confirm that gender stratified analysis was possible. Subsequently, the participants were analyzed according to gender. Multiple logistic regression analysis was performed, while controlling for the previously identified variables that were associated with nutrition label use, to confirm the association between chronic disease and the use of nutrition labels. The same method was used to investigate the association between the state of chronic disease, as defined by the self-report, and the use of nutrition labels. Lastly, the association between the awareness and controls of chronic disease, and the use of nutrition label was analyzed among patients with each chronic disease. All data were statistically analyzed using STATA 12.0 for Windows, and two-sided tests were conducted to set the *P* value at 0.05 or below.

Ethics statement

This study was approved by the institutional review board of Seoul National University Hospital in Seoul, Korea (IRB num-

ber: 1407-003-591). Informed consent was exempted by the institutional review board.

RESULTS

General characteristics of the study participants

The basic characteristics of the study participants are shown in Table 1. Of the 10,695 participants, 2,434 (24.4%) used nutrition labels and 8,261 (75.6%) did not use nutrition labels. Nutrition labels were used by 15.0% of men and 34.0% of women, indicating that women were more likely to use nutrition labels. The mean age of those using nutrition labels was 37.3 yr, whereas the mean age of those not using nutrition labels was 46.1 yr, indicating that younger people were more likely to use nutrition labels. Study participants who used nutrition labels had a lower BMI than those who did not use nutrition labels. Furthermore, people who had a larger number of household members, had a higher household income, or had a higher level of education

were more likely to use nutrition labels. Of those who had received nutrition education, 41.8% used nutrition labels, whereas only 23.6% of those who did not receive nutrition education used nutrition labels. Non-smokers were more likely to use nutrition labels compared with current or ex-smokers. In addition, those who drank alcohol once or less per week were more likely to use nutrition labels compared with non-drinkers or those who drank alcohol twice or more per week.

The association between chronic disease and the use of nutrition labels

Patients with a chronic disease were less likely to use nutrition labels than people without a chronic disease (hypertension 12.2% vs. 27.8%; diabetes 13.2% vs. 25.4%; hyperlipidemia 18.7% vs. 25.1%). Similarly, when the status of chronic disease was defined by self-report, those who had answered that they were diagnosed with chronic disease by a medical professional had a lower rate of nutrition label use (Table 2).

The association between chronic disease and the use of nutrition labels was analyzed by dividing the participants into their respective gender group and controlling for variables that are associated with nutrition label use (Table 3). There was no significant difference in the use of nutrition labels between the group with chronic disease and the group without, for both genders (men with hypertension odds ratio [OR], 0.97; 95% confidence interval [CI], 0.75-1.27; women with hypertension OR, 0.83; 95% CI, 0.67-1.03; men with diabetes OR, 0.70; 95% CI, 0.45-1.08; women with diabetes OR, 1.13; 95% CI, 0.84-1.53; men with hyper-

Table 1. General characteristics of the study population (n = 10,695)

Parameters	Food labeling use		P value*
	No (n = 8,261)	Yes (n = 2,434)	
Age (yr)	46.1 ± 15.7	37.3 ± 10.9	< 0.001
Sex			< 0.001
Male	3,753 (85.0)	529 (15.0)	
Female	4,508 (66.0)	1,905 (34.0)	
BMI (kg/m ²)	23.7 ± 3.3	23.3 ± 3.4	< 0.001
Number of family members			< 0.001
1	717 (84.0)	78 (16.0)	
2	2,307 (84.9)	308 (15.1)	
3	1,826 (74.5)	624 (25.5)	
4+	3,401 (71.7)	1,421 (28.3)	
Household income (quartile)			< 0.001
1st	1,906 (85.3)	191 (14.7)	
2nd	2,049 (77.0)	531 (23.0)	
3rd	2,137 (74.7)	753 (25.3)	
4th	2,014 (70.4)	928 (29.6)	
Education (graduated)			< 0.001
≤ 6 yr	2,825 (95.2)	94 (4.8)	
7-12 yr	3,678 (74.9)	1,291 (25.1)	
> 13 yr	1,732 (65.3)	1,049 (34.7)	
Marriage			< 0.001
Unmarried	889 (68.0)	460 (32.0)	
Divorced or widowed	1,314 (89.0)	133 (11.0)	
Married	6,042 (75.9)	1,838 (24.1)	
Nutrition education			< 0.001
No	7,913 (76.4)	2,236 (23.6)	
Yes	332 (58.2)	198 (41.8)	
Smoking			< 0.001
Non-smoker	4,699 (68.7)	1,801 (31.3)	
Ex-smoker	1,625 (80.7)	319 (19.3)	
Current smoker	1,931 (85.1)	313 (14.9)	
Alcohol drinking frequency			< 0.001
None	2,486 (77.1)	583 (22.9)	
1 per week or less	3,827 (70.7)	1,523 (29.3)	
2 per week or more	1,926 (84.8)	327 (15.2)	

Unit: weighted mean ± SD or number (weighted proportion). *P values were calculated by chi-square test (categorical variables) or t-test (continuous variables). BMI, body mass index.

Table 2. Association between chronic disease status and food labeling use in the study population (n = 10,695)

Diseases	Food labeling use		P value*
	No (n = 8,261)	Yes (n = 2,434)	
Hypertension [†]			< 0.001
No	5,770 (72.2)	2,167 (27.8)	
Yes	2,491 (87.8)	267 (12.2)	
Hypertension (self-reported)			< 0.001
No	6,411 (73.1)	2,261 (26.9)	
Yes	1,850 (89.8)	173 (10.2)	
Hyperlipidemia [†]			< 0.001
No	7,288 (74.9)	2,246 (25.1)	
Yes	973 (81.3)	188 (18.7)	
Hyperlipidemia (self-reported)			< 0.001
No	7,635 (75.1)	2,310 (24.9)	
Yes	626 (82.3)	1243 (17.7)	
Diabetes mellitus [†]			< 0.001
No	7,382 (74.6)	2,324 (25.4)	
Yes	879 (86.8)	110 (13.2)	
Diabetes mellitus (self-reported)			< 0.001
No	7,600 (74.9)	2,357 (25.1)	
Yes	661 (86.4)	77 (13.6)	

Unit: number (weighted proportion). *P values were calculated by chi-square test; [†]Hypertension: systolic blood pressure ≥ 140 mmHg or diastolic blood pressure ≥ 90 mmHg or taking anti-hypertensive medication; Hyperlipidemia: fasting serum total cholesterol ≥ 240 mg/dL or taking anti-hyperlipidemic medication; Diabetes mellitus: fasting glucose ≥ 126 mg/dL or taking anti-diabetic medication or using insulin.

Table 3. Association between chronic disease status and food labeling use by multivariate analysis

Diseases	Male (n = 4,282)				Female (n = 6,413)			
	OR (95% CI)	P value	aOR* (95% CI)	P value†	OR (95% CI)	P value	aOR* (95% CI)	P value†
Hypertension [‡]								
No	1.00		1.00		1.00		1.00	
Yes	0.54 (0.43-0.67)	< 0.001	0.97 (0.75-1.27)	0.852	0.22 (0.19-0.27)	< 0.001	0.83 (0.67-1.03)	0.085
Hypertension (self-reported)								
No	1.00		1.00		1.00		1.00	
Yes	0.41 (0.31-0.56)	< 0.001	0.78 (0.55-1.10)	0.150	0.22 (0.18-0.27)	< 0.001	0.82 (0.64-1.05)	0.118
Hyperlipidemia [‡]								
No	1.00		1.00		1.00		1.00	
Yes	0.79 (0.57-1.11)	0.174	0.85 (0.59-1.23)	0.384	0.53 (0.44-0.64)	< 0.001	1.14 (0.91-1.44)	0.246
Hyperlipidemia (self-reported)								
No	1.00		1.00		1.00		1.00	
Yes	0.90 (0.62-1.32)	0.595	0.98 (0.64-1.48)	0.910	0.56 (0.44-0.71)	< 0.001	1.16 (0.88-1.53)	0.295
Diabetes mellitus [‡]								
No	1.00		1.00		1.00		1.00	
Yes	0.44 (0.30-0.65)	< 0.001	0.70 (0.45-1.08)	0.110	0.40 (0.32-0.51)	< 0.001	1.13 (0.84-1.53)	0.424
Diabetes mellitus (self-reported)								
No	1.00		1.00		1.00		1.00	
Yes	0.45 (0.28-0.72)	0.001	0.74 (0.45-1.23)	0.248	0.35 (0.27-0.47)	< 0.001	1.15 (0.82-1.63)	0.417

*Adjusted for age, body mass index, education, family members, household income, nutrition education, smoking, alcohol, chronic disease status (hypertension, diabetes mellitus, hyperlipidemia); †P value were calculated by multiple logistic regression analysis; ‡Hypertension: systolic blood pressure \geq 140 mmHg or diastolic blood pressure \geq 90 mmHg or taking anti-hypertensive medication; Hyperlipidemia: fasting serum total cholesterol \geq 240 mg/dL or taking anti-hyperlipidemic medication; Diabetes mellitus: fasting glucose \geq 126 mg/dL or taking anti-diabetic medication or using insulin. OR, odds ratio; aOR, adjusted odds ratio; 95% CI, 95% confidence interval.

Table 4. Association between awareness and control of chronic disease and food labeling use

Outcomes by disease	OR (95% CI)	P value	aOR* (95% CI)	P value†
In hypertension patients (n = 2,655)				
Awareness				
No	1.00		1.00	
Yes	0.58 (0.45-0.75)	< 0.001	0.89 (0.64-1.22)	0.466
Control [‡]				
No	1.00		1.00	
Yes	0.91 (0.65-1.27)	0.585	1.08 (0.74-1.57)	0.690
In hyperlipidemia patients (n = 1,123)				
Awareness				
No	1.00		1.00	
Yes	1.12 (0.81-1.53)	0.497	1.55 (1.03-2.35)	0.037
Control [‡]				
No	1.00		1.00	
Yes	1.13 (0.77-1.64)	0.537	2.19 (1.32-3.63)	0.002
In diabetes mellitus patients (n = 945)				
Awareness				
No	1.00		1.00	
Yes	0.77 (0.50-1.19)	0.239	1.30 (0.75-2.26)	0.349
Control [‡]				
No	1.00		1.00	
Yes	0.59 (0.36-0.98)	0.042	0.94 (0.51-1.74)	0.844

*Adjusted for sex, age, body mass index, education, family members, household income, nutrition education, smoking, alcohol, chronic disease status (hypertension, diabetes mellitus, and hyperlipidemia); †P value were calculated by multiple logistic regression analysis; ‡Control of hypertension: systolic blood pressure < 140 mmHg and diastolic blood pressure < 90 mmHg; control of hyperlipidemia: serum total cholesterol < 200 mg/dL; control of diabetes mellitus: HbA1c < 6.5%. OR, odds ratio; aOR, adjusted odds ratio; 95% CI, 95% confidence interval.

lipidemia OR, 0.85; 95% CI, 0.59-1.23; women with hyperlipidemia OR, 1.14; 95% CI, 0.91-1.44). When the status of chronic disease was defined by self-report, there was no significant difference in the use of nutrition labels between the group that was

diagnosed by a medical professional and the group that was not.

Analysis of the association between control or awareness of chronic disease and the use of nutrition labels showed that for hyperlipidemia, those who were aware of the disease (OR, 1.55; 95% CI, 1.03-2.35) or who had good control of cholesterol levels (OR, 2.19; 95% CI, 2.32-3.63) were more likely to use nutrition labels. On the other hand, there was no significant association between awareness or control of disease and nutrition label use in patients with hypertension or diabetes (Table 4).

DISCUSSION

In the current study, data from the fourth KNHANES were used to investigate the relationship between the use of nutrition labels and the presence of chronic disease in adults aged 20 yr and older. Those with chronic disease reported lower usage of nutrition labels compared to the usage for their healthy counterparts; however, analysis after correcting for other variables associated with the use of nutrition labels showed that there was no significant association between the use of nutrition labels and the presence of chronic disease. Furthermore, the results indicated that those who had a good awareness of hyperlipidemia and had good control of it were more likely to use nutrition labels.

Previous studies on the use of nutrition labels in patients with chronic disease showed different results depending on the study method. For example, a study by Lewis and colleagues (16) using the NHANES of the United States showed that patients with chronic diseases, such as hypertension, hypercholesterolemia, diabetes, obesity, and cardiovascular disease, used nutrition la-

bels more frequently than healthy people. In contrast, a study in a Latin population of diabetic patients showed that there was no significant difference in the use of nutrition labels between diabetic patients and non-diabetic participants; however, this study was limited in sample size, with approximately 100 participants in each group (18). In the current study, there was no significant association between the use of nutrition labels by participants without chronic disease and those with chronic disease, such as hypertension, diabetes, and hyperlipidemia. Considering the importance of nutrition for these patients, nutrition label usage by this population requires improvement.

The diagnosis of chronic disease will not affect health related behaviors unless the patient has awareness. In the study by Lewis et al. (16), participants were defined as having a chronic disease if they answered that they had been diagnosed with a chronic disease. In the current study, this definition was not associated with the use of nutrition labels. Those with chronic disease are more likely to have unhealthy lifestyles compared with healthy persons, but patients who are diagnosed with chronic disease can modify their lifestyles if they are interested in their health. In contrast to the study by Lewis et al. (16), the current study may not have found a significant difference in the use of nutrition labels for those with and without chronic disease since nutrition labeling policy was introduced relatively late in Korea. Furthermore, the perception of nutrition labels differs among the Korean population. For example, a study by Chen et al. (22) reported that 80% of healthy adults over the age of 65 yr in the United States used nutrition labels, whereas in the current study only 24.4% of the participants reported that they used nutrition labels.

Several factors can affect the use of nutrition labels. Socio-economic factors such as gender, age, education level, and income as well as the awareness of the relationship between food and chronic disease, and having nutrition knowledge are well known to affect the use of nutrition labels (22). In the current study, older male participants with a lower level of income and education and no exposure to nutrition education, were less likely to use nutrition labels, suggesting that the development of an approach to increase the use of nutrition labels in this population is required. A study by Post et al. (14) on patients with hypertension, diabetes, or hyperlipidemia, showed that those who were advised by a medical practitioner to reduce their intake of calories or fat were 50% more likely to use nutrition labels. Furthermore, those who used nutrition labels consumed less calories, saturated fats, carbohydrates, and sugar, and had a higher intake of fiber. In the current study, participants who had received nutrition education were more likely to use nutrition labels. In contrast, despite the importance of nutrition management in those diagnosed with chronic diseases, these participants did not show different usage of nutrition labels compared with healthy participants. Therefore, the results indicate that more active nutrition education in the management of patients

with chronic disease is required.

To the best of our knowledge, to date no study has analyzed the association between the use of nutrition labels and the awareness and control of chronic diseases. Patients who are actively involved in the management of their chronic disease are more likely to be interested in the nutrient content of foods. In the current study, patients who were aware of their diagnosis of hyperlipidemia or who had good control of it, reported higher rates of nutrition label usage; however, this finding was not observed in participants diagnosed with hypertension and diabetes. The current results suggests that policies on nutrition labeling format may need to be improved to help chronic disease management in patients with hypertension and diabetes mellitus. Recently, the US FDA proposed an update of their nutrition label, adding new nutrients such as added sugar, vitamin D, and potassium (11). This change reflects the latest scientific information, including the link between diet and chronic diseases.

An improved understanding of nutrition labels is required for nutrition label use to have an effect on the management of chronic disease. A study by De la Cruz-Gongora et al. (23) showed that 17% of adult Mexicans used nutrition labels, although only 1.2% of the participants answered all 5 questions on nutrition labels correctly. Sharf et al. (24) also reported that only 27.2% of 120 young adults understood the contents of nutrition labels correctly. In addition, Roberto et al. (25) reported that the caloric consumption was smaller when the daily recommended energy consumption was displayed on the nutrition labels compared with when only the caloric content was shown. These findings suggest that an appropriate nutrition labeling format together with the appropriate knowledge of nutrition labels, can improve the effect of nutrition labeling on chronic disease.

This study has several limitations. Firstly, the data analysis was limited as only the status of overall use of nutrition labels was questioned in the survey. Different nutrients are important in each disease, which can lead to differences in the use of nutrition labels (16). In this study, patients who were aware of their diagnosis of hyperlipidemia or who had good control of it, were more likely to use nutrition labels, whereas this was not observed in those with hypertension and diabetes. Patients with hyperlipidemia are likely to be more interested in the fat and caloric content of foods than other patients, whereas patients diagnosed with hypertension or diabetes are more interested in nutrients in foods that are closely associated to their diseases. Secondly, this was cross-sectional study, and therefore, it cannot explain the causal relationship between nutrition label use and chronic disease. Healthy people may have healthier lifestyles and thus may have higher use of nutrition labels compared to the use in those with chronic diseases. On the other hand, active use of nutrition labels may prevent chronic diseases. Several studies have shown that the use of nutrition labels is associated with a healthier diet (25-27), but additional research is re-

quired to confirm this. Lastly, the use of nutrition labels was assessed by self-directed questionnaires and hence there may be recall bias.

In conclusion, there was no significant difference in the use of nutrition labels in participants with chronic diseases, such as hypertension, diabetes, and hyperlipidemia, compared to the use in those without chronic diseases. Considering the importance of dietary habits in the management of chronic diseases, the use of nutrition labels in these patients requires improvement. In addition, the use of nutrition labels may differ depending on the awareness and control of different types of diseases. Additional research is required for the provision of a tailored approach.

DISCLOSURE

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