

Food label use and awareness of nutritional information and recommendations among persons with chronic disease^{1–3}

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ABSTRACT

Background: Because of the relation between chronic disease and poor nutritional habits, the use of food labels and adherence to dietary recommendations are important for chronic disease populations. We explored whether persons with chronic disease read nutrient information on food labels and whether they were aware of dietary guidelines.

Objective: This study aimed to assess dietary information use among persons with chronic disease by using a nationally representative sample of the US population.

Design: A total of 5603 respondents aged ≥ 17 y from the 2005–2006 National Health and Nutrition Examination Survey participated in the study. This representative sample of US civilians were asked 17 questions regarding their awareness of federal nutrition information and their food label use and were given two 24-h recall dietary interviews. Participants were classified into 5 disease categories: 1) hypertension, 2) hypercholesterolemia, 3) diabetes/at risk of diabetes, 4) overweight, and 5) heart disease.

Results: Subjects with chronic diseases were more aware of nutritional recommendations, checked more often for specific nutrients, and used nutrition information on food labels more often than did participants without such diseases. Label use behavior was inconsistently associated with dietary guideline compliance.

Conclusions: People with chronic disease generally reported better nutrition awareness and food label use and checking behaviors compared with those without chronic disease, but this did not translate into unequivocally better eating behaviors. New strategies are needed to improve the actual nutritional behaviors of persons with chronic disease. *Am J Clin Nutr* 2009;90:1351–7.

INTRODUCTION

To attenuate the morbidity and mortality associated with chronic diseases, American dietary habits need to be modified. Many Americans are suffering from the spectrum of coronary artery and cardiovascular diseases and diabetes (1, 2), which are 3 of the most prevalent chronic diseases. For example, >50 million Americans (>30% of the population) have hypertension, which results in inordinate medical expenses (3); >700,000 Americans lose their life to heart disease every year (4); and 24 million children and adults have diabetes (7.8% of the population), with 57 million Americans having prediabetes or impaired fasting glucose (5). Given the enormous public health costs of these diseases through untimely deaths, disability, or

lost worker productivity, improving the dietary habits of the American population is urgently warranted (6, 7).

The primary national mechanism used to communicate the importance of good dietary habits is through the *Dietary Guidelines for Americans*, which is published jointly every 5 y by the US Departments of Health and Human Services and Agriculture (8). In addition, the United States has mandated nutritional labeling on most food packages through the Nutrition Labeling and Education Act of 1990 (9). These labels were instituted to assist the population in making healthier dietary choices that would ultimately have a positive effect on public health (10). However, despite the detailed nutrition information printed on most food packages, many Americans ignore these labels and continue to make bad dietary choices (11). Even with increasing usage of food labels, many Americans still have difficulty understanding and applying the information in their lives due to deficits in literacy and numeracy and other issues (12).

Several studies have investigated the relation between the use of nutrition label information, health status, and related behaviors with varying results (13–15). For example, in one study, the use of nutrition labels was inversely related to a person's intake of total fat, saturated fat, and cholesterol (15). Another study showed that reading labels was associated with nutrition knowledge, perceived importance of a healthy diet, and an understanding that eating too much fat is related to being unhealthy (15). Furthermore, a study in patients receiving care from medical clinics reported that those individuals reading nutrition labels in the prior year ate less fat and more fruit and vegetables than did subjects who did not use labels (16). Another study showed that $\approx 80\%$ of the participants read labels and that label use was related to eating less fat (14). Finally, a population-based assessment of African Americans showed that the use of nutrition labels was related to obesity, healthy eating self-efficacy (ie, self-confidence in one's ability to eat

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more fruit and vegetables and less fat), a belief in a diet-cancer relation, and trying to lose weight (17).

Although these aforementioned studies have attempted to explain some of the diverse sociodemographic, psychosocial, and attitudinal factors related to using nutritional labels, it is virtually unknown how often nutrition labels are used by people who already have been diagnosed with a chronic disease or condition (eg, hypertension, hypercholesterolemia, heart disease, overweight, or diabetes). In addition to the use of labels, the awareness of basic nutrition information, such as the US dietary guidelines, the Food Guide Pyramid, or the 5-A-Day program, among persons with chronic disease is also uncertain. Thus, the objective of this study was to assess nutrition label and information use among persons with major chronic diseases and to correlate such behaviors with reported dietary habits by using a nationally representative sample of the US population.

SUBJECTS AND METHODS

Data source

The 2005–2006 National Health and Nutrition Examination Survey (NHANES), as part of the ongoing, stratified, multistage probability sample of the US civilian noninstitutionalized population, asked participants 17 questions regarding their awareness of federal nutrition information programs and their use of food labels and asked them to provide two 24-h dietary recalls by interviews conducted on nonconsecutive days, which were used to derive values for total energy and protein, carbohydrate, fat, saturated fat, and fiber in grams (18). Household interviews were conducted in persons aged ≥ 17 y to determine responses to all of these label use and dietary behavior items. Items from the 2005–2006 NHANES survey as described below were used to construct the chronic disease categories, which included 1) hypertension, 2) hypercholesterolemia, 3) diabetes/at risk of diabetes, 4) overweight, and 5) chronic heart disease. A total of 5603 respondents were used for analysis in this study, representing ≈ 222 million people (calculated by using the Current Population Surveys for persons aged ≥ 17 y as recommended in the Centers for Disease Control and Prevention NHANES tutorial “Age Standardization and Population Counts” at http://www.cdc.gov/nchs/tutorials/Nhanes/NHANESAnalyses/AgeStandardization/age_standardization_intro.htm). This study was approved by the University of Miami Institutional Review Board for Human Subjects.

Chronic disease items

For our analysis, we selected chronic diseases inherently related to poor or inadequate nutrition, including hypertension, hypercholesterolemia, diabetes/at risk of diabetes, overweight, and heart disease. These conditions are self-reported within NHANES and are defined by a “yes” response to any of the following questions: 1) Has your doctor ever said you had hypertension or high blood pressure? (hypertension); 2) Has your doctor ever said that your cholesterol was too high? (hypercholesterolemia); 3a) Has your doctor ever said that you had diabetes or sugar diabetes? 3b) Has doctor ever said that you had prediabetes, borderline diabetes, or impaired fasting glucose? 3c) Has your doctor ever said that you had a health risk of di-

abetes? (diabetes/at risk of diabetes); 4) Has your doctor ever said that you were overweight? (overweight); and 5a) Has your doctor ever said that you had heart failure? 5b) Has your doctor ever said that you had coronary heart disease? 5c) Has your doctor ever said that you had angina/angina pectoris? 5d) Has your doctor ever said that you had a heart attack? 5e) Has your doctor ever said that you had a stroke? (heart disease).

Label use behavior items

The NHANES asked detailed questions about behaviors related to using food labels and being aware of nutritional information. Each participant was queried about the following: 1) Have you heard of the *Dietary Guidelines for Americans*? 2) Have you heard of the Food Guide Pyramid? 3) Have you heard of the 5-A-Day program? 4) How often do you use the nutrition facts panel? 5) How often do you use the list of ingredients? 6) How often do you use the size of serving? 7) How often do you use the health claim? 8) How often do you use information about calories? 9) How often do you use the information about calories from fat? 10) How often do you use information about total fat? 11) How often do you use information about trans fat? 12) How often do you use information about saturated fat? 13) How often do you use information about cholesterol? 14) How often do you use information about sodium? 15) How often do you use information about carbohydrates? 16) How often do you use information about fiber? 17) How often do you use information about sugars?

Reported dietary behavior

Participants were interviewed on nonconsecutive days to recall dietary data from two 24-h periods. This recall was analyzed to provide total energy and protein, carbohydrate, fat, saturated fat, and fiber in grams. To analyze how participants in each chronic disease group were actually eating compared with national recommendations for protein, carbohydrate, fat, saturated fat, and fiber, the 2-d average for each of these variables was used. The 2-d average of total energy (calories) was used as the denominator in these calculations. Because protein, carbohydrate, fat, and saturated fat variables are reported in grams, protein (g) and carbohydrate (g) were multiplied by 4 to get protein and carbohydrate in energy (in calories), and fat (g) and saturated fat (g) were multiplied by 9 to get fat and saturated fat in energy (in calories). Each of these 4 categories was divided by the total energy to get the percentage daily intake for each nutrient. To fall within the recommended guidelines of the Institute of Medicine (19), the US Departments of Agriculture and Health and Human Services (20), the American College of Sports Medicine, and the American Dietetic Association (21), we used the following ranges for participants for each macronutrient: 1) protein 10–14% of daily energy, 2) carbohydrate 52–64% of daily energy, 3) total fat $\leq 30\%$ of daily energy, 4) saturated fat $\leq 10\%$ of daily energy, and 5) ≥ 25 g fiber/d. On the basis of their score, participants were then dichotomized as being either “adherent” or “nonadherent” to the guidelines for each of these macronutrients.

Statistical analysis

Frequency and descriptive statistics were calculated on all label use behavior items by age, body mass index (BMI), marital

TABLE 1
Demographic and clinical variables by chronic disease among participants of the 2005–2006 National Health and Nutrition Examination Survey (NHANES)¹

	Hypertension		Hypercholesterolemia		Diabetes/at risk of diabetes		Overweight		Heart disease	
	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Married (%)										
No	78.78 ± 0.84	51.20 ± 1.91	73.36 ± 1.48	56.01 ± 1.27	76.43 ± 0.78	50.75 ± 1.72	80.71 ± 0.79	49.30 ± 1.51	71.61 ± 0.80	50.66 ± 3.32
Yes	21.22 ± 0.84	48.80 ± 1.91	26.64 ± 1.48	43.99 ± 1.27	23.57 ± 0.78	49.25 ± 1.72	19.29 ± 0.79	50.70 ± 1.51	28.39 ± 0.80	49.34 ± 3.32
Race-ethnicity (%)										
Other Hispanic	4.07 ± 0.86	1.91 ± 0.62	2.53 ± 0.69	3.27 ± 0.91	3.23 ± 0.80	4.22 ± 0.82	3.25 ± 0.61	3.89 ± 1.03	3.53 ± 0.81	1.44 ± 0.77
Non-Hispanic white	70.60 ± 2.78	75.40 ± 2.77	76.77 ± 2.79	78.91 ± 2.29	73.20 ± 2.59	67.42 ± 3.43	71.61 ± 2.60	72.71 ± 3.13	71.92 ± 2.72	79.33 ± 3.17
Non-Hispanic black	10.26 ± 1.84	13.66 ± 2.46	10.74 ± 2.12	8.59 ± 1.65	10.48 ± 1.85	14.03 ± 2.62	10.83 ± 1.90	12.18 ± 2.34	10.85 ± 1.95	11.71 ± 2.11
Other	5.42 ± 0.68	4.60 ± 0.88	5.11 ± 0.81	4.67 ± 0.75	4.76 ± 0.63	6.70 ± 1.10	5.42 ± 0.67	4.66 ± 1.07	5.31 ± 0.61	3.40 ± 1.04
Sex (%)										
Female	48.87 ± 0.62	46.41 ± 1.60	44.89 ± 1.75	48.39 ± 1.66	49.82 ± 0.60	42.14 ± 1.42	50.38 ± 0.70	43.26 ± 1.90	47.61 ± 0.61	52.21 ± 3.69
Male	51.13 ± 0.62	53.59 ± 1.60	55.11 ± 1.75	51.61 ± 1.66	50.18 ± 0.60	57.86 ± 1.42	49.62 ± 0.70	56.74 ± 1.90	52.39 ± 0.61	47.79 ± 3.69
Education (%)										
<12	57.07 ± 1.75	53.43 ± 2.63	66.33 ± 1.86	57.88 ± 3.22	55.27 ± 1.72	58.51 ± 2.72	54.90 ± 2.05	58.28 ± 1.90	58.85 ± 1.81	47.18 ± 4.98
= 12	24.08 ± 0.74	27.05 ± 1.68	22.03 ± 1.09	25.92 ± 2.15	25.97 ± 0.91	21.42 ± 1.30	24.83 ± 0.83	25.31 ± 1.38	24.61 ± 0.86	26.60 ± 3.78
> 12	18.85 ± 1.40	19.52 ± 1.91	11.63 ± 1.40	16.20 ± 1.56	18.76 ± 1.39	20.08 ± 1.93	20.27 ± 1.52	16.40 ± 1.51	16.55 ± 1.44	26.22 ± 2.76
Insurance (%)										
No	21.24 ± 1.88	12.85 ± 2.16	12.41 ± 1.37	10.98 ± 2.04	20.28 ± 1.90	13.89 ± 1.91	21.63 ± 1.99	12.88 ± 1.80	19.74 ± 1.92	10.30 ± 2.09
Yes	78.76 ± 1.88	87.15 ± 2.16	87.59 ± 1.37	89.02 ± 2.04	79.72 ± 1.90	86.11 ± 1.91	78.37 ± 1.99	87.12 ± 1.80	80.26 ± 1.92	89.70 ± 2.09
Saw health care professional in last year (%)										
No	20.43 ± 0.88	6.70 ± 1.26	11.69 ± 1.08	8.08 ± 0.91	18.59 ± 0.81	8.82 ± 1.22	19.90 ± 0.79	8.95 ± 0.85	17.72 ± 0.72	1.76 ± 0.56
Yes	79.57 ± 0.88	93.30 ± 1.26	88.31 ± 1.08	91.92 ± 0.91	81.41 ± 0.81	91.18 ± 1.22	80.10 ± 0.79	91.05 ± 0.85	82.28 ± 0.72	98.24 ± 0.56
Age (y)	40.59 ± 0.63	56.65 ± 1.20	47.50 ± 0.74	55.02 ± 0.93	43.89 ± 0.80	49.84 ± 1.24	43.65 ± 0.88	48.56 ± 0.89	44.94 ± 0.66	65.05 ± 1.15
BMI (kg/m ²)	27.47 ± 0.26	30.79 ± 0.25	28.52 ± 0.30	29.81 ± 0.26	27.52 ± 0.18	31.69 ± 0.52	25.79 ± 0.15	34.20 ± 0.25	28.45 ± 0.25	30.13 ± 0.30

¹ All values are means ± SEs. For hypertension, 5077 participants were observed from a population of 203,600,000; for hypercholesterolemia, 2960 were observed from a population of 140,400,000; for diabetes/at risk of diabetes, 5088 were observed from a population of 203,900,000; for overweight, 5085 were observed from a population of 203,800,000; and for heart disease, 4352 were observed from a population of 193,700,000.

status, ethnicity-race, sex, and education for each of the 5 disease categories. We used a principal components factor analysis with an oblique rotation to form scales from the 17 label use behavior questions. A polychoric correlation matrix was used as the basis of this analysis because the items were mostly 5-point Likert scales, except for the 3 binary “awareness” items. To determine which items were associated with each factor, we chose items from the reference structure matrix that had a semipartial correlation coefficient of ≥ 0.50 . Cronbach’s coefficient α was calculated for each scale to determine internal consistency. Linear regression was then used to calculate the means and standard errors for the label use behavior scales adjusted for the demographic variables. The Statistical Analysis System (SAS) 9.21 (SAS Institute Inc, Cary, NC) was used for data management and all analyses. SAS survey procedures were used to perform weighted analyses that adjusted for the design effects of the complex sampling used for NHANES. The percentages and standard errors shown in Table 1 were computed by PROC SURVEYFREQ, and the means and standard errors were produced by PROC SURVEYMEANS. The factor analysis results in Table 2 were unweighted because the polychoric correlation routine that computes the correlation matrix used in the factor analysis does not accommodate weights. The means and standard errors in Tables 3 and 4 were computed by the ESTIMATE statement in PROC SURVEYREG and were adjusted for the covariates in Table 1 (ie, age, BMI, marital status, race-ethnicity, sex, education, insurance status, and doctor’s visit).

RESULTS

The numbers of eligible respondents who did or did not have the self-reported chronic disease and demographic and clinical characteristics, including age, sex, race-ethnicity, education, BMI, marital status, health insurance coverage, and at least one

TABLE 2
Semipartial correlation coefficients from the factor analysis reference matrix and coefficients α for the 3-label questionnaire scales

Dietary behavior item	Scale		
	Check	Use	Aware
Check total fat on food label	0.69		
Check saturated fat on food label	0.69		
Check calories from fat on food label	0.67		
Check <i>trans</i> fat on food label	0.66		
Check cholesterol on food label	0.62		
Check calories on food label	0.59		
Check carbohydrates on food label	0.57		
Check sodium on food label	0.54		
Check fiber on food label	0.53		
Check sugars on food label	0.52		
Use ingredient list on food label		0.75	
Use health claims on food packages		0.70	
Use serving size info on food label		0.67	
Use nutrition facts panel on food label		0.63	
Heard of Food Guide Pyramid			0.86
Heard of 5-A-Day program			0.84
Heard of dietary guidelines			0.83
Coefficient α	0.95	0.88	0.70

TABLE 3
Factor analysis of the dietary behavior scales according to chronic disease¹

Chronic disease/label use	No	Yes	P value
Hypertension			
Aware	1.33 \pm 0.05	1.42 \pm 0.05	0.012
Use	8.95 \pm 0.16	9.44 \pm 0.23	0.021
Check	27.34 \pm 0.58	27.95 \pm 0.65	0.346
Hypercholesterolemia			
Aware	1.45 \pm 0.07	1.48 \pm 0.06	0.418
Use	9.68 \pm 0.31	10.19 \pm 0.26	0.005
Check	29.26 \pm 0.88	30.68 \pm 0.72	0.014
Diabetes/at risk of diabetes			
Aware	1.28 \pm 0.05	1.47 \pm 0.05	<0.001
Use	8.98 \pm 0.18	9.75 \pm 0.22	0.005
Check	27.31 \pm 0.56	29.81 \pm 0.64	<0.001
Overweight			
Aware	1.28 \pm 0.05	1.46 \pm 0.06	0.001
Use	8.93 \pm 0.16	9.76 \pm 0.21	<0.001
Check	27.41 \pm 0.57	28.47 \pm 0.64	0.001
Heart disease			
Aware	1.31 \pm 0.05	1.20 \pm 0.07	0.136
Use	9.29 \pm 0.17	8.61 \pm 0.41	0.043
Check	28.13 \pm 0.54	28.21 \pm 1.17	0.923

¹ All values are means \pm SEs. The range of scores for each of the 3 factors was as follows: “Aware” (0–3.0), “Use” (4.0–20.0), and “Check” (10.0–50.0). Values were calculated by using linear regression analysis and were adjusted for age, BMI, marital status, race-ethnicity, sex, education, insurance status, and doctor’s visit in prior year.

medical visit in the prior year are shown in **Table 1**. These data varied considerably with chronic disease status but were not compared statistically because they are reported only for descriptive purposes.

Factor analysis

We computed 3 scales from the factor analysis of the 17 label use behavior items. The 3 factors accounted for 79% of the total variance. The reference structure matrix and α -coefficients for the 3 computed scales shown in **Table 2**, are as follows: 1) checking for specific micro- or macronutrients on the label for total, saturated, and *trans* fat and total calories and calories from fat, cholesterol, carbohydrates, sodium, fiber, and sugar (“Check”); 2) using general information on the packaging, such as the ingredient list on the label, health claims on packages, serving size information, and nutrition facts panel (“Use”); and 3) being aware of national recommendations and guidelines of the Food Guide Pyramid, the 5-A-Day program, and the US dietary guidelines (“Aware”). After the scales were formed, they were scored by summing the item responses. “Check” is the sum of 10 items with responses of 1–5; “Use” is the sum of 4 items that range from 1 to 5; and “Aware” is the sum of 3 items with responses of 0 or 1.

Linear regression

The multivariate-adjusted means and standard errors for the “Check,” “Use,” and “Aware” scales for each of the 5 chronic disease categories, comparing those who did and those who did not have a disorder, are shown in **Table 3**. Those with hypertension used more label and package information ($P = 0.021$)

TABLE 4
Summed scores for label use behavior scales for adherence to dietary guidelines for protein, carbohydrate, fat, saturated fat, and fiber according to chronic disease^a

Nutrient/ label use	Hypertension			Hypercholesterolemia			Diabetes/at risk of diabetes			Overweight			Heart disease		
	Nonadherent	Adherent	P value	Nonadherent	Adherent	P value	Nonadherent	Adherent	P value	Nonadherent	Adherent	P value	Nonadherent	Adherent	P value
Carbohydrate															
Aware	1.34 ± 0.12	1.25 ± 0.12	0.042	1.32 ± 0.06	1.18 ± 0.08	0.088	1.57 ± 0.07	1.42 ± 0.08	0.012	1.51 ± 0.07	1.38 ± 0.09	0.103	1.66 ± 0.14	1.43 ± 0.15	0.079
Use	9.61 ± 0.48	10.00 ± 0.42	0.169	10.16 ± 0.37	10.19 ± 0.49	0.906	9.96 ± 0.36	9.96 ± 0.33	0.980	10.29 ± 0.20	9.97 ± 0.35	0.221	8.77 ± 1.15	9.52 ± 1.03	0.306
Check	30.48 ± 1.64	31.37 ± 1.47	0.200	31.49 ± 1.16	31.52 ± 1.15	0.972	30.96 ± 1.04	32.29 ± 1.33	0.143	30.51 ± 0.77	29.87 ± 0.66	0.332	27.28 ± 1.70	28.12 ± 1.77	0.396
Fiber															
Aware	1.29 ± 0.12	1.41 ± 0.13	0.221	1.27 ± 0.05	1.49 ± 0.12	0.043	1.48 ± 0.07	1.69 ± 0.11	0.034	1.46 ± 0.07	1.51 ± 0.10	0.580	1.52 ± 0.10	1.45 ± 0.21	0.732
Use	9.67 ± 0.46	10.83 ± 0.70	0.032	10.07 ± 0.40	11.01 ± 0.59	0.039	9.71 ± 0.32	11.02 ± 0.51	0.002	9.99 ± 0.25	10.86 ± 0.40	0.032	9.16 ± 1.07	12.24 ± 1.02	0.000
Check	30.93 ± 1.54	32.27 ± 2.06	0.339	31.64 ± 1.14	33.12 ± 1.38	0.218	31.58 ± 0.96	32.76 ± 1.47	0.311	30.32 ± 0.65	30.82 ± 0.89	0.481	29.73 ± 1.10	36.17 ± 1.68	0.001
Protein															
Aware	1.34 ± 0.12	1.17 ± 0.13	0.023	1.30 ± 0.06	1.18 ± 0.07	0.110	1.55 ± 0.07	1.44 ± 0.09	0.237	1.48 ± 0.07	1.43 ± 0.09	0.392	1.59 ± 0.11	1.53 ± 0.15	0.555
Use	9.92 ± 0.45	9.22 ± 0.53	0.099	10.30 ± 0.41	9.75 ± 0.40	0.017	10.29 ± 0.31	8.98 ± 0.32	0.000	10.39 ± 0.23	9.59 ± 0.34	0.005	9.18 ± 1.20	8.93 ± 1.14	0.629
Check	31.34 ± 1.60	28.80 ± 1.80	0.072	32.12 ± 1.17	29.60 ± 0.93	0.005	31.90 ± 1.05	29.17 ± 1.33	0.002	30.93 ± 0.80	28.39 ± 0.78	0.006	28.57 ± 1.64	26.67 ± 2.03	0.254
Total fat															
Aware	1.34 ± 0.12	1.25 ± 0.13	0.291	1.28 ± 0.07	1.25 ± 0.05	0.647	1.58 ± 0.08	1.43 ± 0.07	0.079	1.47 ± 0.08	1.45 ± 0.07	0.741	1.62 ± 0.11	1.49 ± 0.15	0.256
Use	9.66 ± 0.45	9.97 ± 0.50	0.324	9.99 ± 0.40	10.49 ± 0.46	0.095	9.77 ± 0.37	10.30 ± 0.40	0.239	10.10 ± 0.22	10.33 ± 0.36	0.483	8.40 ± 1.04	10.07 ± 1.11	0.009
Check	30.34 ± 1.60	31.54 ± 1.58	0.097	30.88 ± 1.12	32.56 ± 1.27	0.040	30.75 ± 1.02	32.29 ± 1.57	0.278	29.99 ± 0.85	30.86 ± 0.73	0.364	26.35 ± 1.74	29.11 ± 1.81	0.014
Saturated fat															
Aware	1.31 ± 0.13	1.30 ± 0.12	0.778	1.26 ± 0.07	1.29 ± 0.05	0.739	1.57 ± 0.08	1.46 ± 0.06	0.082	1.49 ± 0.07	1.43 ± 0.08	0.140	1.60 ± 0.12	1.53 ± 0.13	0.479
Use	9.43 ± 0.49	10.25 ± 0.46	0.022	9.83 ± 0.43	10.70 ± 0.43	0.018	9.62 ± 0.35	10.47 ± 0.39	0.016	10.03 ± 0.24	10.41 ± 0.28	0.078	8.28 ± 1.07	10.09 ± 1.08	0.013
Check	29.74 ± 1.59	32.22 ± 1.54	0.001	30.28 ± 1.20	33.36 ± 1.26	0.003	30.06 ± 1.24	33.29 ± 0.98	0.002	29.85 ± 0.74	31.04 ± 0.70	0.054	26.07 ± 1.67	30.11 ± 1.94	0.018

^a All values are means ± SEs. The range of scores for each of the 3 factors was as follows: "Aware" (0–3.0), "Use" (4.0–20.0), and "Check" (10.0–50.0). Values were calculated by linear regression analysis and were adjusted for age, BMI, marital status, race/ethnicity, sex, education, insurance status, and doctor's visit in the prior year.

and were more aware of national dietary recommendations ($P = 0.012$) than those who did not have hypertension. Participants with hypercholesterolemia showed more behaviors related to checking for nutrient information on labels ($P = 0.014$) and used more label and package information ($P = 0.005$) than those with normal cholesterol. Subjects with diabetes or who were at risk of diabetes and/or who were overweight displayed greater awareness of national dietary recommendations, used more label and package information, and checked for nutrient information on labels when measured against those without diabetes or who were not at risk of diabetes or of normal weight, respectively (all P values <0.01). Participants who did not have heart disease used more label and package information than did their counterparts with heart disease ($P = 0.043$). Thus, in general, persons with a history of chronic disease reported that they checked and used label and package information and were more aware of guidelines than those who did not have chronic disease.

Analysis of covariance between label use scales reported dietary behavior scores

The means and standard errors (adjusted by age, BMI, marital status, race-ethnicity, sex, education, insurance status, and doctor's visit in prior year), calculated by using the label use scales as dependent variables and the reported dietary behavior scores as independent variables for participants who had 1 of the 5 chronic diseases, divided by adherent or nonadherent to the dietary guidelines for each macronutrient according to the methodology described above, are shown in **Table 4**. Significant differences were observed for the following: 1) carbohydrate and protein and "Aware," fiber and saturated fat and "Use," and saturated fat and "Check" for hypertension; 2) fiber and "Aware," protein and total and saturated fat and "Check," and fiber, protein, and saturated fat and "Use" for hypercholesterolemia; 3) carbohydrate and fiber and "Aware," protein and saturated fat and "Check," and fiber, protein, and saturated fat and "Use" for diabetes/at risk of diabetes; 4) fiber and protein and "Use" and protein and "Check" for overweight; and 5) fiber and total and saturated fat and "Use" and fiber and total and saturated fat and "Check" for heart disease. In summary, the label use scales ("Aware," "Use," and "Check") were related to nonadherence to dietary recommendations for carbohydrate and protein consumption, whereas the scales were related to adherence to dietary recommendations for fiber and total and saturated fat, particularly for heart disease. All other differences between groups were nonsignificant.

DISCUSSION

In this population-based study of Americans with different chronic diseases known to have at least a partial dietary etiologic component (hypertension, hypercholesterolemia, diabetes/at risk of diabetes, overweight, and heart disease), we examined nutrition label use by checking behaviors and awareness of national nutrition information campaigns and by comparing such behaviors with reported dietary intake. After reducing the 17 individual label use behavior items to 3 well-defined scales (ie, "Check," "Use," and "Aware"), we found that persons with chronic diseases checked and used nutritional label information and were more aware of national nutrition recommendations than

those participants who did not report having such diseases. In particular, those with diabetes/at risk of diabetes and/or who were overweight reported significantly more checking, using, and awareness behaviors than did their nondiabetic and normal weight counterparts, respectively. The results of our study are strengthened by using the NHANES, which provides a data set that is generalizable to the US population.

The results of our study provide useful information for policy makers who are planning future national nutrition information campaigns. Although using labels and being aware of nutritional information before being diagnosed with chronic disease would be preferable, reversal of disease symptoms is possible with lifestyle changes, such as adopting healthier eating habits (22, 23). Thus, providing information about using nutrition labels and about the key national campaigns may prove beneficial for people attending primary care or specialty medical clinics in encouraging the adoption of healthier dietary behaviors. In addition, people who use labels and are aware of important nutritional information may have certain dietary concerns and want to limit their consumption of fat and/or total calories, obtain adequate amounts of key nutrients, and/or increase fiber consumption. Another study showed that label users believed that nutrition information is important in making food choices compared with those who did not use labels (24).

In this study, we also compared label use behaviors with reported dietary behavior scores that were derived from the reported intake of protein, carbohydrate, total fat, saturated fat, and fiber. Participants were dichotomized into whether or not they adhered to daily recommendations for each of these nutrients and then the scores on the check, use, and aware factors were compared for adherent and nonadherent subgroups for each chronic disease group. Our analysis reveals a relation between those participants with hypertension, hypercholesterolemia, overweight, or diabetes/at risk of diabetes and those who were nonadherent for dietary recommendations for carbohydrate or protein; these participants also scored higher on awareness of national dietary guidelines or using or checking dietary labels. In contrast, participants representing all 5 chronic diseases, particularly heart disease, who adhered to dietary recommendations for fiber and total and saturated fat scored higher on the aware, use, and check factors. Thus, we would surmise that the use of information on nutrition labels and being more aware of nutritional recommendations is related to meeting the daily recommendations for fiber and total and saturated fat. However, greater use of labels and awareness of recommendations may not necessarily preclude other healthier behaviors. The use and awareness of dietary information has been positively correlated with increased nutrition knowledge and more favorable attitudes about labels in a study of college students (25), which suggests that nutrition knowledge is an important factor in food label use.

Limitations of this study include not being able to determine whether participants are using and checking labels only for certain foods and/or whether or not labels are being compared for different foods. Participants might be using certain foods as benchmarks—whether they are healthy or not—to make comparisons between amount of fat, number of calories, or amount of sodium, for example, to make a purchasing decision without any understanding of what is considered a healthy amount of these nutrients to consume daily. If the participant is uninformed about how much of what nutrients to consume, especially someone who

has already been diagnosed with one of these chronic diseases, then the use of nutrition labels may be less than effective. We also do not know if a participant is checking the label only the first time that a product is bought and thus may not feel the need to look at the label for successive purchases.

Another limitation is the inability to ascertain causality, given the cross-sectional nature of the study. Although it is more plausible that the presence of chronic disease preceded the initiation of food label use and awareness of nutrition information, it is possible that a person was making use of food labels and was aware of nutrition information before receiving a diagnosis of a chronic disease. Thus, food label use and nutrition awareness prior to diagnosis with a chronic disease implies that somehow the nutrition information gained from reading labels and attained from other sources is not as effective as it is believed to be, that it is not being used properly, or that it is confusing the individual in ways that prevent positive health outcomes. Furthermore, we do not know whether the diagnosed participants are making use of nutrition labels and are more aware of dietary recommendations in response to being told about their medical condition. We also do not know where these participants are receiving their advice to use nutrition information and recommendations, but one likely source would be the physician's office.

The results of our study suggest that those people who have been diagnosed with a chronic disease may be open to increasing healthy dietary behaviors, given their greater use of nutrition labels and awareness of national nutrition recommendations. However, just because people know about and use labels does not necessarily translate into healthy dietary behavior. Thus, within the spectrum of these chronic diseases, opportunities may exist to further increase the use of food labels and the awareness of nutritional recommendations in the context of improving healthy dietary behaviors by using tailored, disease-specific messages. Given that higher intakes of certain nutrients (eg, fat, *trans* fat, and saturated fat) are linked to a greater risk of heart disease and other chronic conditions (26, 27), individuals without disease who do not use label information compared with those already diagnosed with a disease would benefit from label information and perhaps reduce their risk of developing these diseases. Nonetheless, continued efforts at increasing the use of food labels and promoting awareness of nutritional information and recommendations are critically important in attempting to curtail the various epidemics of chronic disease that the United States currently faces.

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REFERENCES

- Sanders TA. High- versus low-fat diets in human diseases. *Curr Opin Clin Nutr Metab Care* 2003;6:151–5.
- Weisburger JH. Lifestyle, health and disease prevention: the underlying mechanisms. *Eur J Cancer Prev* 2002;11(suppl 2):S1–7.
- Chobanian AV, Bakris AL, Black HR, et al. The seventh report of the joint national committee on prevention, detection, evaluation, and treatment of high blood pressure: the JNC 7 report. *JAMA* 2003;289:2560–72.
- Centers for Disease Control and Prevention. Deaths: leading causes for 2002. Atlanta, GA: US Department of Health and Human Services, Centers for Disease Control and Prevention, 2005. (Report no. 53.)
- Centers for Disease Control and Prevention. National diabetes fact sheet: general information and national estimates on diabetes in the United States, 2007. Atlanta, GA: US Department of Health and Human Services, Centers for Disease Control and Prevention, 2008.
- Kung HC, Hoyert DL, Xu JQ, Murphy XL. Deaths: final data for 2005. Hyattsville, MD: National Center for Health Statistics, 2008. [Report no. 56(10).]
- Bhattacharya J, Choudhry K, Lakdawalla D. Chronic disease and severe disability among working-age populations. *Med Care* 2008;46:92–100.
- US Department of Health and Human Services and US Department of Agriculture. Dietary guidelines for Americans, 2005. 6th ed. Washington, DC: US Government Printing Office, 2005.
- Nutrition Labeling and Education Act of 1990. HR 3562. Waxman HA, 1990.
- Scarborough FE. Perspectives on nutrition labeling and education act. In: Shapiro R, ed *The nutrition labeling handbook*. New York, NY: Marcel Dekker, 1995:29–52.
- Wang G, Fletcher S, Carley D. Consumer utilization of food labeling as a source of nutrition information. *J Consum Res* 1995;29:368–80.
- Rothman RL, Housam R, Weiss H, et al. Patient understanding of food labels: the role of literacy and numeracy. *Am J Prev Med* 2006;31:391–8.
- Kim S, Nayga R, Capps O. The effect of food label use on nutrient intakes: an endogenous switching regression analysis. *J Agric Res Econ* 2000;25:215–31.
- Neuhouser ML, Kristal AR, Patterson RE. Use of food nutrition labels is associated with lower fat intake. *J Am Diet Assoc* 1999;99:45–53.
- Lin CT, Lee JY, Yen ST. Do dietary intakes affect search for nutrient information on food labels?. *Soc Sci Med* 2004;59:1955–67.
- Kreuter MW, Brennan LK, Scharff DP, Lukwago SN. Do nutrition label readers eat healthier diets? Behavioral correlates of adults' use of food labels. *Am J Prev Med* 1997;13:277–83.
- Satia JA, Galanko JA, Neuhouser ML. Food nutrition label use is associated with demographic, behavioral, and psychosocial factors and dietary intake among African Americans in North Carolina. *J Am Diet Assoc* 2005;105:392–402.
- Centers for Disease Control and Prevention. National Health and Nutrition Examination Survey. NHANES 2005–2006 Diet behavior and nutrition documentation file. 2007. Available from: http://www.cdc.gov/nchs/data/nhanes/nhanes_05_06/dbq_d.pdf (cited 5 November 2008).
- Institute of Medicine Food and Nutrition Board. Dietary reference intakes for energy, carbohydrate, fiber, fat, fatty acids, cholesterol, protein, and amino acids (macronutrients). Washington, DC: National Academies Press, 2002.
- US Department of Agriculture and US Department of Health and Human Services. Nutrition and your health: dietary guidelines for Americans, 2000. 5th ed. Washington, DC: US Government Printing Office, 2000.
- American College of Sports Medicine, American Dietetic Association, Dietitians of Canada. Joint position statement: nutrition and athletic performance. *Med Sci Sports Exerc* 2000;32:2130–45.
- Shintani TT, Beckham S, Brown AC, O'Connor HK. The Hawaii diet: ad libitum high carbohydrate, low fat multi-cultural diet for the reduction of chronic disease risk factors: obesity, hypertension, hypercholesterolemia, and hyperglycemia. *Hawaii Med J* 2001;60:69–73.
- Ornish D, Scherwitz LW, Billings JH, et al. Intensive lifestyle changes for reversal of coronary heart disease. *JAMA* 1998;280:2001–7.
- Smith SC, Taylor JG, Stephen AM. Use of food labels and beliefs about diet-disease relationships among university students. *Public Health Nutr* 2000;3:175–82.
- Marietta AB, Welshimer KJ, Anderson SL. Knowledge, attitudes, and behaviors of college students regarding the 1990 Nutrition Labeling Education Act food labels. *J Am Diet Assoc* 1999;99:445–9.
- Hu FB, Stampfer MJ, Manson JE, et al. Dietary fat intake and the risk of coronary heart disease in women. *N Engl J Med* 1997;337:1491–9.
- Oh K, Hu FB, Manson JE, Stampfer MJ, Willett WC. Dietary fat intake and risk of coronary heart disease in women: 20 years of follow-up of the nurses' health study. *Am J Epidemiol* 2005;161:672–9.