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ORIGINAL RESEARCH

Assessment of Knowledge and Self-Reported Use of Nutrition Facts Labels, Nutrient Content, and Health Claims among Saudi Adult Consumers

Leila Arfaoui[1]
Areej Alkhaldy[1]
Ahad Alareeshi[1]
Ghadeer AlSaadi[1]
Shaima Alhendi[1]
Afnan Alghanmi[1]
Wejdan Alghafari[1]
Mourad Assidi[2,3]

[1]Clinical Nutrition Department, Faculty of Applied Medical Sciences, King Abdulaziz University, Jeddah, 21589, Saudi Arabia; [2]Center of Excellence in Genomic Medicine Research, King Abdulaziz University, Jeddah, 21589, Saudi Arabia; [3]Medical Laboratory Department, Faculty of Applied Medical Sciences, King Abdulaziz University, Jeddah, 21589, Saudi Arabia

Background: Few studies have investigated the knowledge and attitudes towards the nutrition facts label, the nutrient content and health claims (NHCs) among consumers from different countries/cultures.

Methods: This cross-sectional study assessed the knowledge and self-reported use of the nutrition facts label and NHCs among Saudi adults. A total of 722 participants were recruited using an online questionnaire.

Results: Total knowledge score was 5.8 ± 2.5/13 points (45%). Approximately, 18%, 77%, and 5% of the participants had low, medium, and high levels of knowledge, respectively. Participants were more knowledgeable on the nutrition facts label (2.6 ± 1.6/5 points) and health claims (2.7 ± 1.2/4 points) versus nutrient content claims (0.5 ± 0.7/4 points). The total use score was 20.1 ± 5.7/30 points (67%); approximately, 2%, 61%, and 37% of the participants were classified as low, medium, and high use level, respectively. Participants' use of the nutrition facts label, nutrient content claims, and health claims was 10.0 ± 3.1/15, 6.5 ± 2.2/9, and 3.6 ± 1.8/6 points, respectively.

Conclusion: This study highlights the need for more education and public awareness programs to enhance consumer knowledge and use of the nutrition facts label and NHCs, and consequently lead to healthy dietary choices.

Keywords: health claims, knowledge, nutrition facts label, nutrient claims, nutritional information

Introduction

Optimal nutrition intake is one of the main lifestyle factors that contribute to a reduced incidence of obesity and noncommunicable diseases.[1] Nutrition facts, nutrient content, and health claims (NHCs) on food labels may be an effective tool for communicating nutritional information to consumers.[2] Thus, the effort of public health agencies to help consumers make healthy food choices and encourage them to use the nutrition facts and declarations of NHC may be a cost-effective approach to reducing the prevalence of obesity and noncommunicable diseases worldwide.[3,4]

The nutrition facts label and NHCs are permitted in an increasing number of countries given the continued growth of online food shopping.[5] The main nutritional information on food labels (eg, nutritional content, list of ingredients, serving size, and nutrient and health benefit claims) help consumers to understand the nutritional composition of a product and make informed decisions in selecting foods to achieve a healthy diet.[2] Yet, the research in this area of knowledge and

Correspondence: Leila Arfaoui
Tel +966 126401000 (ext. 41612)
Email leila.arfaoui@gmail.com

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food label use is limited. Previous research studies reported an association between knowledge regarding the nutrition facts label and healthier dietary decisions.[6] For example, 6% less dietary fat was found among consumers who used the nutrition facts label compared with those who did not, accounting for a significant decrease in the risk of diet-related chronic diseases.[7,8] In addition, a Korean study exploring the association between macronutrients and micronutrients intake and nutrition label reading among adults showed that males who used nutrition labels had higher consumptions of calcium and vitamin C than those who did not.[9] In the same study, those who used nutrition labels among females consumed less carbohydrates and calories than those who did not. Moreover, individuals with higher incomes and higher educational levels were more likely to use nutrition labels.[9]

Sufficient nutritional knowledge is powerful as it improves attention, comprehension and memory, and makes the decision-making process more orderly and efficient.[2,4] The cognitive processing model suggests that consumers with prior knowledge tend to use label information more effectively than those without knowledge.[2]

Nutrition facts labels and NHCs are most commonly used by consumers with specific health conditions, and those following restricted diets, such as patients with diabetes or hyperlipidemia.[10] Moreover, consumers who frequently read food labels focus mainly on calories, sugar, and fat information when purchasing unfamiliar foods.[11–13] Existing evidence shows a noticeable lack of understanding and use of NHCs among consumers, either due to insufficient nutrition knowledge, confusion, or underestimation of nutrient value.[5,14,15] Ares et al reported that a lack of nutrition knowledge diminishes consumers' understanding of health claims, thereby reducing the credibility of such claims.[5,16] Other factors that have been reported to influence knowledge and use of NHC include familiarity, credibility, and availability in supermarkets,[17,18] in addition to consumer awareness and interest in healthy eating.[18,19]

On an international basis, most studies performed thus far focused on nutrition facts labels, while few studies included NHC.[2] The internationalization of food systems and integration of markets and industries is increasing. Furthermore, studies from different cultures are increasingly required to learn from and collaborate with other international colleagues. This approach links food choice data and determines the influence of cultural factors on these choices. Further studies regarding consumers' knowledge of nutrition facts labels worldwide are also required to identify the factors influencing the knowledge, attitudes, confidence, and decision-making of the consumer. This sharing will ultimately advance knowledge to empower consumers to achieve informed dietary choices, decrease the prevalence of diet-related diseases, and improve public health.

In Saudi Arabia, the Saudi FDA has implemented general labeling requirements on prepackaged food items, imported, exported and locally produced, available in the country's market since 2013. These SFDA policies were reinforced by its adherence to the Cooperation Council for the Arab States of the Gulf regulation to disclose the nutritional data on food product labels [Gulf Standard Organization (GSO) 2233/2012]. Moreover, a recent study about nutrition food labelling in Saudi Arabia showed that among the 1153 food products randomly sampled from fourteen stores, 88% displayed nutritional facts.[20] Therefore, this study was conducted to assess the level of consumers' knowledge and self-reported use of food labels and NHCs among Saudi adults. Moreover, the relationships between consumer knowledge and self-reported use and various participant characteristics (eg, age, sex, education, and income) were assessed.

Materials and Methods

Study Design and Participants

This cross-sectional study was conducted between January 20 and March 15, 2020. A total of 722 participants aged ≥18 years were included in the study via convenience sampling. An online survey, created using Google Forms, was distributed through various social media applications, such as WhatsApp and Twitter. Ethical approval was obtained from the Research Ethics Committee at King Abdulaziz University Hospital in Jeddah, Saudi Arabia (Ref. number: 772–19). The study was performed according to the ethical standards of the 1964 Declaration of Helsinki. Informed consent was obtained from all participants.

Sample Size Calculation

The sample size of the included participants was calculated using the online Epi Info sample size calculator supported by the Division of Health Informatics & Surveillance, and Center for Surveillance, Epidemiology and Laboratory Services.[21] The data were obtained from

the (blinded for peer review) General Authority for Statistics (2019) and included an estimated total of 25,828,206 adults (aged >18 years). The effective sample size for this study was 664 participants, with a 99% confidence interval and hypothesized 50% frequency of outcome factor in the population.

Survey and Data Collection

The survey was developed using a questionnaire validated by the United States Food and Drug Administration[22] with some modifications to cover the study aim. The survey was shared with 30 individuals for piloting to assess the timing, consistency, and clarity of the survey. Based on the feedback from the pilot survey, some questions were reworded and some of the groupings of questions/statements were changed. In addition, some response options for certain questions were changed. The final survey included three sections with a total of 39 questions. The beginning of the survey informed participants regarding the purpose of the study, desired outcomes of the survey, estimated time for survey completion, confidentiality, information on ethical approval, and contact persons for more details about the study.

The first section of the survey (13 questions) covers the participants' information, including their sociodemographic profile (age, sex, group, marital status, educational level, occupation, income level, and whether their grocery shopping was done personally). This was followed by questions concerning their health status (presence of any chronic disease or food allergy) and use of any special diet. In the same section, the participants were also asked how they perceived their health in general.

The second section of the survey (13 questions) was dedicated to determining the consumers' knowledge of nutrition facts labels and NHCs. They were asked about the recommended daily calories for males and females. Participants were subsequently exposed to a sample of a juice box nutrition facts label and were requested to respond to three questions regarding the serving size, calorie content, and amount of total sugar. In addition, participants were asked to explain the meaning of terms included in the nutrition facts label, such as sugar-free, calorie-free, light, and low sodium claims. The last four questions in this section examined the participants' knowledge about the health claims. They were asked whether vitamin D, fat, sodium, and fiber intake affects the risk of osteoporosis, heart disease, hypertension, and diabetes mellitus, respectively (four possible response options were provided: increase; decrease; no effect; or no known effect). Only one of these four responses were deemed to be correct and received a score of 1; wrong responses received a score of 0. The total knowledge of nutrition facts labels and NHC was evaluated by summing the scores of the thirteen questions and categorizing the results as "high" (>75th percentile), "medium" (50th–75th percentile), and "low" (<50th percentile).

The third section of the survey (13 questions), regarding the use of nutrition facts labels and NHCs, began with a question about how often the consumer read nutrition facts labels (always, sometimes, rarely, or never). Participants who indicated that they were always or sometimes reading the food labels continued to complete the remaining questions (subsection a). These questions assessed the frequency (often, sometimes, rarely, or never) of reading the following five parts in the nutrition facts label: list of ingredients, nutrition information, serving size, calories, and claims. The participants were subsequently asked about the use of the following five claims when buying products: low fat, no added sugar, light, diet rich in fiber helps to reduce the risk of diabetes mellitus, and low sodium helps to lower the risk of hypertension. The four responses were scored from 0 to 3, with higher scores indicating frequent usage. The total use of nutrition facts labels and NHCs was evaluated by summing the scores of the thirteen questions and categorizing the results as "high" (>75th percentile), "medium" (50th–75th percentile), and "low" (<50th percentile).

In addition, participants were asked about how frequently (often, sometimes, rarely, or never) they read the following reasons to compare between brands and food items, make sure that the advertisement on the package is true, and check the nutrient content and level as well as the recommended serving size. Participants who indicated that they rarely or never read nutrition facts labels were asked a follow-up question (subsection b) to determine the reason for this answer, and the remaining of the survey was not completed. Five reasons for not reading nutrition facts labels (ie, not interested, not understandable, time consuming, using other sources, or I know what to eat) were provided, to which participants could respond "yes", "no", or "I don"t know'.

Statistical Analysis

Data were analyzed using the SPSS software (Version 23.0; IBM Corp., Armonk, NY, USA.). Data were described using frequency statistics and descriptive

statistics are presented as mean and Standard deviation (SD). A chi-squared test of independence and analysis of variance were used to test the difference between two variables. A $p<0.05$ denoted statistical significance. A Bonferroni correction was applied for multiple comparisons. To determine the predictors of participants' knowledge and use of nutrition labels and NHCs claims, forward stepwise multiple regression analyses were performed using participants' characteristics as potential predictors variables.

Results

Participant Characteristics

Table 1 presents the characteristics of the study participants. A total of 722 participants, with a response rate of 98%, agreed to fill out the survey. Of those, approximately 60% were females, 67.4% were aged <35 years, 80% had Bachelor's degree or above, 40.9% were employed, 36% worked in the healthcare sector, and 41% had children.

Approximately, 57% of the participants shared grocery shopping with the family. Around 16% of the participants suffered from a chronic disease, mainly diabetes, hypertension and heart diseases. About 13% of the participants had food allergies, particularly relating to nuts/seeds (n=35), fish/shellfish (n=17), milk/dairy products (n=15), eggs (n=9), and others (eg, banana, strawberries, and mango) (n=15). Almost 20% of the participants followed a specific diet, such as the Keto diet (n=20), low-calorie diet (n=39), low-carbohydrate diet (n=21), low-fat diet (n=17), sugar-free diet (n=12), high-protein diet (n=6), intermittent fasting (n=7), vegetarian/vegan diet (n=6), and other diets (n=12). In terms of health perception, 19.1% of the participants reported poor-to-fair health, whereas the remaining 80.9% thought they had a good-to-excellent health.

Table 1 Participant Characteristics (n=722)

Variable		n	%
Gender	Male	285	39.5
	Female	437	60.5
Age (years)	18–25	315	43.6
	26–35	172	23.8
	36–55	182	25.2
	≥ 56	53	7.4
Educational level	≤ Elementary school	4	0.6
	High school	140	19.4
	≥ Bachelor	578	80.0
Work status	Student	274	38.0
	Employed	295	40.9
	Unemployed	93	12.9
	Retired	60	8.2
Monthly income (SR)	< 5000	145	20.1
	5000–10,000	169	23.4
	10,001–15,000	119	16.5
	> 15,000	289	40.0
Work related to healthcare	No	461	63.9
	Yes	261	36.1
Medical diagnosis	No diseases	609	84.3
	Diabetes (n=40)	113	15.7
	Hypertension (n=33)		
	Heart diseases (n=14)		
	Gastrointestinal diseases (n=6)		
	Thyroid diseases (n=9)		
	Asthma (n=11)		
Food allergy	No	631	87.4
	Yes	91	12.6
Following diet	No	582	80.6
	Yes	140	19.4
Having children	No	421	58.3
	Yes	301	41.7
Grocery shopping	All the time	158	21.9
	Most of the time	151	20.9
	Shared with family	413	57.2
Health perception	Poor	22	3.0
	Fair	116	16.1
	Good	214	29.6
	Very good	241	33.4
	Excellent	129	17.9

Abbreviations: n, number of participants; SR, Saudi Riyal.

Knowledge of the Nutrition Facts Label and NHCs

Table 2 shows the knowledge of the participants towards the nutrition facts label and NHCs. Only 37% and 38% of the participants were aware of the recommended calories for females and males, respectively. Using the nutritional fact sample of a box of juice, approximately 48% of the participants knew the serving size, 68% reported a correct answer for the calories content, and 72% were able to determine the calories and total sugar content. However, only 12%, 16%, 15%, and 4% of the respondents could explain the meanings of "sugar-free", "calorie-free", "light or lite in fat", and "low sodium", respectively. Approximately three-quarters (72%) of the participants

Table 2 Participants' Corrected Answers to Nutrition Facts Label and NHCs's Knowledge Questions (n=722)

Knowledge questions	Recommended calories and nutrition facts label questions										Nutrient content claims meaning questions								Health claims relationship questions								Total knowledge (mean ± SD)	*p*-value
	Calories recommended for females		Calories recommended for males		Serving size: 2 boxes of juice		Calories intake: 2 boxes of juice		Total sugar content in 1 box of juice		"Sugar-free"		"Calorie-free"		"Light" or "Lite"		"Low sodium"		Vitamin D deficiency and osteoporosis		High fat intake and heart diseases		High sodium intake and hypertension		High fiber intake and DM			
Knowledge score (mean ± SD)	2.6 ± 1.6										0.5 ± 0.7								2.7 ± 1.2								5.8 ± 2.5	
Corrected answers (n, %)	274	38	264	37	349	48	493	68	521	72	89	12	116	16	107	15	29	4	522	72	615	85	514	71	299	33		
Age (years)																												
18–25	136	50	126	48	177	51	250	51	255	49	49	55	61	53	49	46	17	59	228	44	267	43	223	43	107	36	6.2 ± 2.4	
26–35	63	23	66	25	88	25	114	23	123	24	24	27	29	25	33	31	9	31	115	22	143	23	116	23	73	24	5.8 ± 2.5	**< 0.001***
36–55	64	23	61	23	73	21	109	22	114	22	14	16	22	19	20	19	3	10	137	26	161	26	138	27	91	30	5.5 ± 2.5	
≥56	11	4	11	4	11	3	20	4	29	6	2	2	4	3	5	5	0	0	42	8	44	7	37	7	28	9	4.6 ± 2.4	
Gender																												
Male	94	34	86	33	124	36	175	35	185	36	31	35	38	33	36	34	8	28	186	36	224	36	178	35	112	37	5.2 ± 2.5	**< 0.001***
Female	180	66	178	67	225	64	318	65	336	64	58	65	78	67	71	66	21	72	336	64	391	64	336	65	187	63	6.2 ± 2.4	
Educational level																												
≤Elementary school	1	0	2	1	1	0	3	1	3	1	0	0	0	0	2	2	0	0	2	0	2	0	1	0	1	0	4.5 ± 3.3	**0.057**
High school	52	19	52	20	57	16	92	19	100	19	12	13	21	18	23	21	5	17	90	17	113	18	95	18	45	15	5.4 ± 2.4	
≥Bachelor	221	81	210	80	291	83	398	81	418	80	77	87	95	82	82	77	24	83	430	82	500	81	418	81	253	85	5.9 ± 2.5	
Work status																												
Student	121	44	113	43	158	45	216	44	223	43	47	53	57	49	41	38	16	55	205	39	236	38	203	39	90	30	6.3 ± 2.4	
Employed	112	41	108	41	138	40	193	39	202	39	30	34	40	34	46	43	10	34	202	39	249	40	196	38	138	46	5.6 ± 2.5	**< 0.001***
Unemployed	29	11	30	11	42	12	65	13	68	13	7	8	14	12	13	12	2	7	72	14	80	13	70	14	39	13	5.7 ± 2.5	
Retired	12	4	13	5	11	3	19	4	28	5	5	6	5	4	7	7	1	3	43	8	50	8	45	9	32	11	4.5 ± 2.3	
Monthly income (SR)																												
<5000	54	20	58	22	67	19	92	19	99	19	23	26	28	24	24	22	8	28	95	18	113	18	91	18	48	16	5.5 ± 2.7	
5000–10,000	64	23	55	21	69	20	106	22	126	24	23	26	33	28	31	29	6	21	131	25	150	24	124	24	69	23	5.8 ± 2.4	**0.304**
10,001–15,000	35	13	37	14	53	15	80	16	83	16	12	13	21	18	17	16	5	17	85	16	105	17	86	17	58	19	5.7 ± 2.5	
>15,000	121	44	114	43	160	46	215	44	213	41	31	35	34	29	35	33	10	34	211	40	247	40	213	41	124	41	5.9 ± 2.4	

(*Continued*)

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Table 2 (Continued).

Knowledge questions	Recommended calories and nutrition facts label questions										Nutrient content claims meaning questions								Health claims relationship questions								Total knowledge (mean ± SD)	*p*-value
	Calories recommended for females		Calories recommended for males		Serving size: 2 boxes of juice		Calories intake: 2 boxes of juice		Total sugar content in 1 box of juice		"Sugar-free"		"Calorie-free"		"Light" or "Lite"		"Low sodium"		Vitamin D deficiency and osteoporosis		High fat intake and heart diseases		High sodium intake and hypertension		High fiber intake and DM			
Work related to healthcare																												
No	153	56	150	57	181	52	283	57	317	61	46	52	51	44	62	58	8	28	309	59	379	62	293	57	171	57	5.2 ± 2.4	**< 0.001***
Yes	121	44	114	43	168	48	210	43	204	39	43	48	65	56	45	42	21	72	213	41	236	38	221	43	128	43	6.8 ± 2.3	
Having children																												
No	173	63	164	62	232	66	317	64	322	62	62	70	81	70	67	63	21	72	303	58	354	58	299	58	157	53	6.1 ± 2.4	**0.001 ***
Yes	101	37	100	38	117	34	176	36	199	38	27	30	35	30	40	37	8	28	219	42	261	42	215	42	142	47	5.4 ± 2.5	
Following diet																												
No	231	84	220	83	284	81	408	83	427	82	73	82	92	79	91	85	24	83	431	83	510	83	419	82	241	81	5.7 ± 2.5	**< 0.001***
Yes	43	16	44	17	65	19	85	17	94	18	16	18	24	21	16	15	5	17	91	17	105	17	95	18	58	19	6.4 ± 2.2	
Grocery shopping																												
All	50	18	52	20	65	19	90	18	97	19	14	16	18	16	31	29	8	28	99	19	126	20	100	19	71	24	5.2 ± 2.5	
Most	60	22	60	23	68	19	95	19	103	20	21	24	29	25	17	16	7	24	113	22	124	20	108	21	63	21	5.75 ± 2.33	**0.001***
Some	164	60	152	58	216	62	308	62	321	62	54	61	69	59	59	55	14	48	310	59	365	59	306	60	165	55	6.1 ± 2.5	
Health perception																												
Poor	4	1	11	4	5	1	8	2	10	2	2	2	1	1	11	10	0	0	0	0	10	2	11	2	14	5	4.4 ± 2.2	
Fair	44	16	48	18	57	16	80	16	85	16	15	17	13	11	20	19	4	14	11	2	106	17	91	18	42	14	5.4 ± 2.6	**0.002***
Good	70	26	65	25	87	25	129	26	144	28	19	21	40	34	27	25	13	45	85	16	181	29	148	29	93	31	5.9 ± 2.2	
Very good	89	32	87	33	121	35	179	36	186	36	29	33	36	31	32	30	7	24	147	28	210	34	172	33	101	34	5.9 ± 2.5	
Excellent	67	24	53	20	79	23	97	20	96	18	24	27	26	22	17	16	5	17	100	19	108	18	92	18	49	16	6.3 ± 2.4	

Notes: *Data are presented as number (n) and percentage (%). The *p*-values for $\chi 2$ tests were calculated for age, gender, educational level, work status, monthly income, having children, following diet, grocery shopping, and health perception.

Abbreviations: DM, diabetes mellitus; NHCs, nutrient content and health claims; SR, Saudi Riyal; SD, standard deviation.

knew that vitamin D deficiency and high sodium levels increase the risk of osteoporosis and hypertension, respectively. Approximately 85% of the participants were conscious of the association between high fat intake and the risk of heart diseases. However, only one-third (33%) knew that high fiber intake lowers the risk of diabetes mellitus.

Overall, the mean knowledge score was 5.8 ± 2.5 of a maximum of 13 points (45%). Participants' knowledge of nutrition facts label (2.6 ± 1.6) and health claims (2.7 ± 1.2) was similar, but higher than that for the nutrient content claims (0.5 ± 0.7). Using the percentile thresholds indicated in the Methods section, the number of participants classified as having lower, medium, and high knowledge was 128 (18%), 555 (77%), and 39 (5%), respectively.

Results of the associations between participant characteristics and the total knowledge of nutrition facts label and NHCs showed that females had significantly higher knowledge than males ($p < 0.001$) (Table 2). Moreover, younger participants (aged 18–25 years) had higher overall knowledge than older participants ($p < 0.001$). Students were shown to have higher significant knowledge ($p < 0.001$) than employed, unemployed, and retired participants. Additionally, participants employed in occupations related to the healthcare sector had higher knowledge scores ($p < 0.001$) than those working in other domains. It was also noted that participants who did not have children had a higher knowledge score regarding nutrition facts label and NHCs ($p = 0.001$). Participants who shared grocery shopping with the family tended to have a higher knowledge score versus those who personally did all or most of the grocery shopping ($p = 0.001$). Participants who followed a special diet had more knowledge of nutrition labels than those who did not. Moreover, participants who rated their health status as excellent tended to have higher knowledge ($p = 0.002$).

Self-Reported Use of the Nutrition Facts Label and NHCs

Table 3 shows the participants' answers to questions regarding the use of the nutrition facts label and NHC. Approximately 19% and 44% of the participants reported that they always or sometimes read the nutrition facts label, respectively, representing nearly two-thirds of the study population. However, 27.9% of the participants reported that they rarely or never (9.5%) read the nutrition facts label and NHC.

Among participants who reported that they always or sometimes read nutrition facts label when purchasing food items, approximately 36%, 38%, and 31% stated that they often read the list of ingredients, the nutrition facts, and the serving size, respectively. About 46% of the participants indicated that they read the calories content, and only 21% appeared to pay attention to claims. Additionally, participants often based food purchases on the inclusion of the following claims in the nutrition facts label: "low fat" (48%), "no added sugar" (44%), and "light or lite" (38%). In contrast, only 20% and 25% declared reading the health claims "diet rich in fiber helps to reduce the risk of diabetes mellitus" and "low sodium helps to lower the risk of hypertension", respectively.

Overall, the mean usage score was 20.1 ± 5.7 of a maximum of 30 points (67%). Participants' usage was as follows: nutrition facts label (10.0 ± 3.15 of 15 points), nutrient content claims (6.5 ± 2.2 of 9 points), and health claims (3.6 ± 1.8 of 6 points). Using the percentile thresholds indicated in the Methods section, the number of participants classified with lower, medium, and high use was 9 (2%), 275 (61%), and 168 (37%); respectively.

Results of the associations between participants' characteristics and the nutrition facts label and NHC use showed that only gender had significant effects ($p = 0.010$). Notably, females had higher usage scores than males ($p = 0.010$), and "consumers following diet" were more likely to use nutrient content and health claims on the nutrition facts label ($p = 0.040$).

Figure 1 illustrates the most common reason for using the nutrition facts label among participants who answered that they always or sometimes read the nutrition facts label. Around 46% of the participants reported often using the nutrition facts label and NHC to compare different food items as well as to check the content of nutrients in food. Approximately 40% of the participants often used the nutrition facts label and NHC to determine the presence of an ingredient to avoid, obtain information on the nutritional content, or decide which brand of a food item to buy. Lastly, about one-third of the participants declared that they often used food labels to plan meals, check whether the advertising is true, and determine the quantity of the food product they or their family should consume.

Among the participants who answered that they rarely or never read the nutrition facts label, 63% reported that it is time-consuming, or they were not interested. Other

Table 3 Participants' Answers to Nutrition Facts Label and NHC Self-Reported Use Questions (n=722)

Questions				
1. How often do you read food labels? (n=722)	**n**			**%**
Always	136			9.5
Sometimes	315			27.9
Rarely	202			43.6
Never	69			18.8
a. When you buy a food product, how often do you read the following information on food labels? (n=451)	**Often (%)**	**Sometimes (%)**	**Rarely (%)**	**Never (%)**
Nutrition facts label regarding reading				
List of ingredients	36.2	44.3	14.4	5.1
Nutrition facts	38.9	44.1	14.4	2.7
Serving size	31.0	36.4	21.9	10.7
Calories	46.3	35.0	14.6	3.9
Claims	20.9	35.5	28.6	15.1
Mean nutrition facts label score ± SD	**10.04 ± 3.15**			
b. How often do you use the information below when you buy a food product? (n=451)				
1. Nutrient content claims regarding using				
"Low fat" when purchasing a food product	48.4	35.5	11.7	4.4
"No added sugar" when purchasing a food product	44.3	37.7	13.1	4.9
"Light" or "Lite in calories" when purchasing a food product	38.4	36.8	14.2	10.6
Mean nutrient content claims score ± SD	**6.5 ± 2.2**			
2. Health claims regarding using … … … … when purchasing a food product				
"diet rich in fiber helps to reduce the risk of diabetes mellitus"	20.6	32.1	34.6	12.6
"low sodium helps to reduce the risk of hypertension"	25.3	36.4	22.8	15.5
Mean health content claims score ± SD	**3.6 ± 1.8**			
Total use score (mean ± SD)	**20.1 ± 5.7**			

Abbreviations: NHCs, nutrient content and health claims; n, number of participants; SD, standard deviation.

participants declared that they already knew the foods they purchased (56%), have difficulty in understanding the provided information (50%), or have other preferred sources of nutrition information (41%) (Figure 2). Interestingly, we compared the nutrition facts label information and health claims knowledge between the participants who never/rarely read food labels and those who sometimes/always read them. The former group of participants had significantly higher knowledge scores ($p < 0.001$) than the latter group (Figure 3).

We subsequently compared the knowledge score between the participants who always/sometimes (6.3 ± 2.4 points) and rarely/never (5.0 ± 2.4 points) read the nutrition facts label information and NHCs. The results showed that the former group had significantly ($p < 0.0001$) higher knowledge scores than the latter group.

Predictors of Nutrition Facts Labels and NHCs Knowledge and Use

The overall scores of nutrition facts labels and NHCs knowledge as well as use were subjected to multiple regression analyses with participants' characteristics as potential predictors variables. The regression model of both knowledge and use were statistically significant [$F(7, 718) = 13.517$, $p < 0.001$)] and [$F(2, 447) = 6.626$, $p < 0.01$)], respectively. Among participants' characteristics gender, educational level, following a special diet, health status, jobs related to health sector, occupation, and participation in grocery shopping were

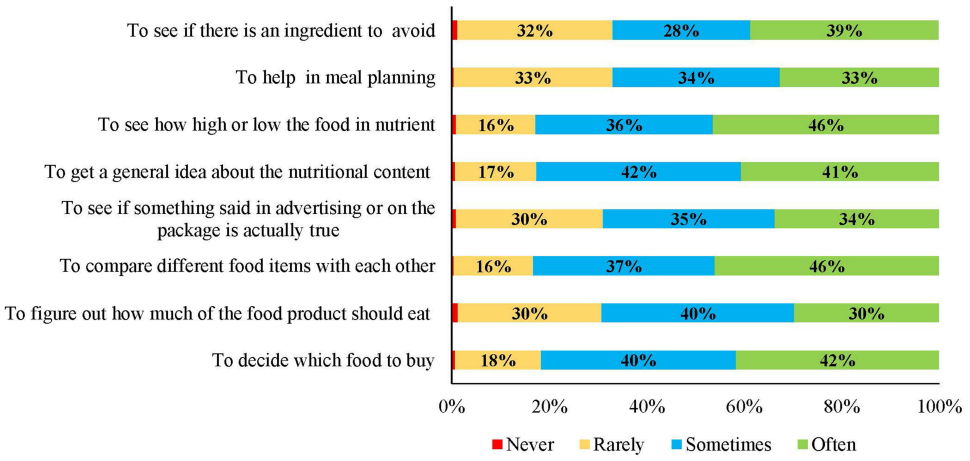

Figure 1 Reasons for using nutrition facts label among participants who answered always or sometimes reading the label (n=451).

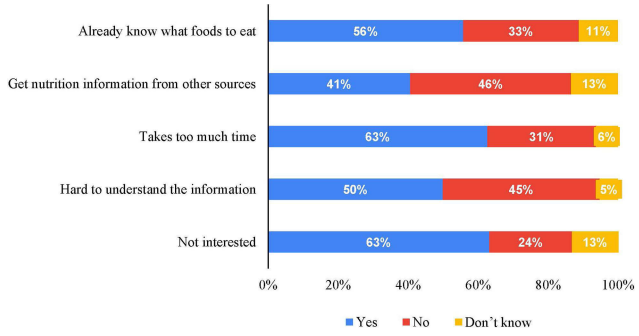

Figure 2 Participants' reasons for rarely or never using nutrition facts label (n=271).

found to be significant predictors of nutrition facts labels and NHCs knowledge (Table 4). In fact, males, retired participants, those who have jobs not related to health sector, persons who did all grocery shopping exclusively by themselves, who does not follow a diet as well as those who declared having poor or fair health, have less knowledge scores comparing to their counterparts (β <0; negative correlation). In addition, educational level has a significant positive correlation with knowledge which means that participants having bachelor's degree or above have higher nutrients and health knowledge score than others.

Only gender and following diet were identified as significant predictors of nutrition facts labels and NHCs use (β <0; negative correlation) (Table 4). Males and persons who are not following diet had lower usage score of nutrition facts labels and NHCs than females, and those following a diet, respectively.

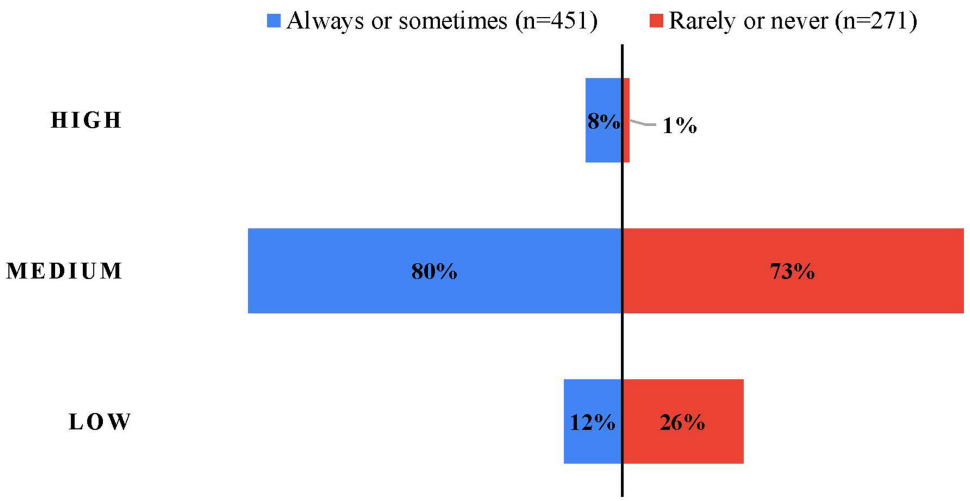

Figure 3 Distribution of the total nutrition facts label and NHCs knowledge scores among participants who always/sometimes read food labels versus those who rarely/never read them (n=722, p<0.001).

Table 4 Predictors of Nutrition Facts and NHCs Knowledge and Use

Nutrition Facts and NHCs Knowledge					
Variables		**β**	***p***	**CI 95%**	
Gender	Male	−0.798	<0.001**	−1.154	−0.443
	Female	Reference category			
Educational level	Bachelor and above	0.448	0.045*	0.011	0.886
	Elementary/ Middle/High School	Reference category			
Occupation	Student	0.382	0.104	−0.079	0.842
	Retired	−0.696	0.034*	−1.339	−0.052
	Employed /unemployed	Reference category			
Jobs related to health sector	No	−1.453	<0.001**	−1.823	−1.084
	Yes	Reference category			
Grocery shopping	All	−0.423	0.047*	−0.841	−0.006
	Some/most	Reference category			
Following diet	No	−0.761	0.001**	−1.179	−0.342
	Yes	Reference category			
Health Status	Poor	−1.813	<0.001**	−2.801	−0.825
	Fair	−0.560	0.003**	−0.929	−0.191
	Good/ very good/excellent	Reference category			
Nutrition facts and NHCs use					
Variables		**β**	***p***	**CI 95%**	
Gender	Male	−1.475	0.007**	−2.553	−0.397
	Female	Reference category			
Following diet	No	−1.450	0.018*	−2.646	−0.255
	Yes	Reference category			

Notes: **$p < 0.01$; *$p < 0.05$.
Abbreviations: NHCs, nutrient and health claims, β is the standardized coefficient; CI, confidence interval.

Discussion

Currently, there is conflicting findings about the importance of prior knowledge and attitude towards nutrition facts label. Studies conducted in Western countries proposed that education and nutrition knowledge are important factors prior to food selection, and may improve the use of nutrition facts label and NHCs;[23,24] yet, a few studies suggest that nutritional knowledge has no direct association with food. This discrepancy could be due to differences in sample size, ethnicity of the examined population, research methods used, study time, and other participant characteristics. Therefore, no firm conclusions can be drawn, and additional research studies from different countries including different sample characteristics are warranted. The present study was performed to assess consumers' knowledge and self-reported use of the nutrient facts label and NHCs among Saudi consumers. The findings of this study could contribute to the existing global evidence related to estimating the knowledge status and use among consumers. Moreover, the results may help to promote informed healthy dietary choices and purchasing knowledge, as well as enlighten consumers about recommended food choices. This information could be used to develop tailored educational and public awareness programs for consumers in Saudi Arabia and countries with similar cultural characteristics.

Overall, the mean knowledge score was 45%. The knowledge regarding the nutrition facts label (52%) and health claims (67%) was higher compared with that for the nutrient content claims (12%). Similar low knowledge scores for nutrient content claims were reported in previous studies carried out in the UK and Italy, where consumers had greater knowledge of health claims than nutrient content claims.[14,25] This could be attributed to the observation that consumers tend to view food as being healthier if it carries a health claim.[5] Other studies have suggested that even if consumers are familiar with nutrient content claims, they may not be able to understand their proper meaning or impact on health.[17] In addition, it is thought that consumers pay more attention to health claims as a result of the effects of marketing and advertisements. Moreover, consumers rely more on noticeable information presented on the front of food packages when their purchase decisions are made quickly in supermarkets.[26,27]

About 62% of the study population declared that they always or sometimes used the nutrition facts label and NHCs when purchasing food items. This percentage was higher than those found in other countries culturally close to Saudi Arabia, such as Bahrain (42%), Turkey (16%), and Malaysia (45%).[27–29] This high usage of nutrition facts label and NHCs in Saudi Arabia may be due mainly to the higher educational level of our cohort. In fact, 80% of our cohort have a bachelor's degree or above, however, only 15%, 35% and 60% of the participants were university graduated in Turkey, Malaysia and Bahrain, respectively.[27–29] Similar positive statistical correlations between the level of education and consumer's reading and using food labels were also reported elsewhere.[27,28,30] Therefore, further studies with larger and more representative samples are warranted to be able to generalize the findings. The high frequency of food label use in Saudi Arabia may also be the result of the recent significant efforts of the Ministry of Health in delivering public health promotion programs and raising health awareness about healthy dietary choices, obesity prevention, physical activity promotion, diabetes control, and cardiovascular disease.[31,32] In addition, in 2018, the Saudi Food and Drug Authority launched a strategy of healthy food regulation which aimed "to reduce the levels of sugar, salt and saturated and transformed fat in the food products".[33] Food manufacturers and importers were required to provide products with lower sugar, salt, saturated, and trans-fat contents. These efforts could help to raise consumers' awareness about the importance of reading nutritional information and claims on food labels to plan an individualized and healthy diet.

In the present study, overall, the participants exhibited better usage than knowledge regarding the nutrition facts label and NHCs. Higher knowledge scores were noted among participants who always/sometimes read the nutrition facts label information and NHC. It has been reported that prior nutritional knowledge could support the use of nutrition facts labels.[2] This is achieved by enabling the consumers to focus on important information in the nutrition facts label and ignore the marketing advertainments, facilitate their memory and comprehension of nutrition facts labels, and support the application of the remembered and comprehended information to making healthy food choices.[2] In addition, prior knowledge, education, and greater experience have also been shown to impact consumer attitude toward NHCs and support the understanding of NHCs.[2]

Although participants have higher usage than knowledge scores in both nutrition facts and nutrient claims, it is important to highlight that this trend was reversed in the health claims section. In fact, although 71% of participants knew that high sodium levels increase the risk of hypertension and 33% were aware that high fiber intake lowers the risk of diabetes mellitus, only 25% and 20% of participants, respectively, used these two health claims when purchasing food products. In line with these findings, an Italian study showed that 36% of consumers often purchased food products with nutrient content claims; however, this percentage decreased to 26% for health claims.[14] Thus, it appears that participants lack trust in the health claims on food labels. This is consistent with a public mindset in Saudi Arabia and globally that only drugs—not nutrients—can treat health problems or improve the health status.

In this study, about one-third of the respondents declared they rarely or never read food labels because it is time-consuming or they were not interested. Other participants also declared that they already knew the foods they purchased. Half of the participants indicated that they have difficulty in understanding the food labels. Similar results were found in South Africa, where "not interested" and "buying the same type of product all time" were the main reasons for not reading food labels.[34] Additional reasons for not reading the nutritional information on food labels, such as "small print on food labels", "difficult terminology", and "inability to understand nutritional

labels", were also recorded in other studies.[35,36] Therefore, further studies are warranted to investigate the factors that could be used to enhance the use of labels.

The most frequent reasons provided for reading food labels among respondents who declared that they always/sometimes read them were to check the contents of nutrients in food (eg, calories, salt, vitamins, or fat) and compare food items. This awareness of Saudi consumers regarding the importance of healthy food choices is attributed to the government awareness and education initiatives discussed earlier in this article. These findings are also in line with those reported by Shine et al[37] who found that consumers paid most attention to the nutrient content in foods. Another study also emphasized the existence of relationships between the use of food labels, and both health awareness and lifestyle behavior.[38] The presence of these relationships demonstrates that consumers who often read food labels tend to care more for their health and maintain a healthy lifestyle.[38]

Notably, respondents who always/sometimes read food labels exhibited higher knowledge scores than participants who rarely or never read food labels. Similar results were shown in the review article published by Miller and Cassady, in which they demonstrated that nutrition knowledge strongly influences food label use by facilitating the comprehension of nutrition information and supporting the application of that information to make food choices.[39] Lack of nutrition knowledge reduces the ability of consumers to understand a health claim, thereby limiting the credibility of these claims.[16]

We investigated the associations between the demographic characteristics of the respondents and knowledge and use of food labels and NHCs. The results showed that female respondents exhibited higher knowledge and usage scores than males regarding nutrition and health claims. Similar results were previously reported in different countries.[27,28,40] This may be due to the level of responsibility and key role of females in household grocery shopping in the Saudi society, as reported elsewhere.[41] A significant association was also found between knowledge scores and younger participants (aged 18–25 years), which is consistent with the findings reported elsewhere.[9,42] This age group, which most likely includes students or recent graduates, is more connected than ever before via technology, smartphone applications, and social media; therefore, they can easily access the web to obtain specific knowledge about NHC. Moreover, knowledge regarding the nutrition facts label and NHCs was found to be higher among participants who did not have children (consistent with findings reported elsewhere[34]) and those sharing grocery shopping with their family. This higher level of knowledge may be explained by the fact that respondents have more time available to read food labels compared with parents and child-caring parents in charge of household shopping. As expected, participants working in the healthcare sector had more knowledge about nutrient and health claims. This greater knowledge may be due to their expertise in health-related topics, including nutrition and dietetics. Additionally, results demonstrated that respondents who followed a specific diet had a high level of knowledge and use regarding nutrient and health claims. Their specific diet requirements (fat, sugar, sodium), medical conditions, or personal preferences may encourage them to focus more and benefit from both nutrition fact information and NHCs, as shown by several previous studies.[28,34,43] For instance, it has been found that diabetic patients search for foods with a low glycemic index.[28] Moreover, health motivation and an interest in healthy eating are among the reported motivators of consumer interest in nutrition information on food products and NHCs use.[18,19] Moorman and Matulich also reported that consumers who require information about food, diet, and health spend more time searching for this information.[44]

To further validate these associations, stepwise regression analyses were performed to identify predictors of knowledge and use of nutrition fact labels and NHCs in our cohort. For knowledge section, educational level, health status, health-related jobs, and participation in grocery shopping were shown to be significant predictors of nutrition facts labels and NHCs knowledge. Interestingly, only gender and following diet were identified as significant predictors of both knowledge and use as reported elsewhere.[9,24,42]

This study had some limitations. Firstly, the cross-sectional design does not address causality and we were only able to demonstrate associations. Secondly, the use of convenience sampling and the social media to distribute the online survey may have affected the generalizability of the data and introduced some slight bias. However, convenience sampling and utilization of social media are considered time- and cost-effective methods for the collection of responses from a large population. A study involving a larger cohort with different socio-demographic characteristics is needed to evaluate more accurately the knowledge and use of food labels and NHCs among Saudi

individuals. Thirdly, since our data involved a large cohort from different parts of Saudi Arabia, that are not reachable during the COVID-19 pandemic, it was difficult to measure the weight and height of participants, and so have their BMI. This parameter would be helpful to further explain its possible effects on knowledge and use of food labels and NHCs.

Conclusions

Despite the high level of education in our sample, there is a clear need for more efforts to enhance the knowledge and use of the nutrition facts label and NHCs. The aims of these efforts would be to help the public make informed and individualized healthy dietary choices. The outcomes of this study highlight the need to initiate educational programs that further enhance consumers' ability to understand information included in the nutrition facts label and NHCs. Awareness campaigns could be conducted at schools, universities, shopping malls, and workplaces, focusing mainly on the meaning of common nutrient claims and their appropriate use. Increased consumer awareness would also encourage food industries to produce more palatable and healthier products, with clear and simple NHCs and nutrition information that can be easily assimilated and applied by consumers, in addition to tangible nutrition and health benefits. Additional intervention studies are warranted to monitor consumers' nutritional knowledge and ensure that such knowledge is applied to the use of the nutritional information presented on food labels.

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Author Contributions

All authors made substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; took part in drafting the article or revising it critically for important intellectual content; agreed to submit to the current journal; gave final approval of the version to be published; and agree to be accountable for all aspects of the work.

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