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ORIGINAL ARTICLE

Understanding of sodium content labeled on food packages by Japanese people

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Salt reduction is one of the most important lifestyle modifications for the prevention of hypertension. The health promotion law regulates the labeling of the nutrient content of food in Japan and, the level of sodium, not salt (sodium chloride), has to be printed on the labels of manufactured foods. In order to control their salt intake, consumers need to apply a conversion factor to the sodium levels listed on the labels to obtain the salt equivalent. However, it is not known whether people have the knowledge appropriate for making the conversion. We carried out a questionnaire survey at the 7th National Shokuiku (food education) Conference in 2012, asking subjects to determine the salt equivalent of 1000 mg of sodium on food labels. We also asked about the target values of salt reduction in grams in the Dietary Reference Intakes for Japanese 2010 (DRI2010) and the Guidelines for Management of Hypertension 2009 by the Japanese Society of Hypertension (JSH2009). We analyzed the data from 683 respondents (169 men and 514 women); only 13.3% of respondents gave a correct answer for the salt equivalent of 1000 mg of sodium (2.50–2.60 g), whereas 61.8 and 40.4% of respondents chose the correct target values for salt reduction according to DRI2010 and JSH2009, respectively. In conclusion, few people could convert sodium content to salt, which suggested difficulty in using food labels to control their salt intake. Salt content in grams, not sodium content, should be labeled on food packages for effective salt reduction and prevention of hypertension.
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Keywords: food label; hypertension; nutrition; salt; sodium

INTRODUCTION

Salt reduction is one of the most important lifestyle modifications to prevent hypertension in Japan, where cardiovascular disease is a major cause of mortality and the average salt intake is higher than that in western countries.[1–4] For effective salt reduction, sufficient nutrition information must be provided on food labels so that consumers can make better decisions. For effective food choices in the context of nutrition and health, consumers need to know the amount of specific nutrients contained in a product and assess how much is considered a low or high amount of the nutrient.[5] Studies in western countries reported that people who look at food labels frequently and use them to make nutritional choices were more likely to eat healthier foods.[6]

In Japan, food labeling regarding nutritional content is regulated by the Health Promotion Act, which defines the nutrients that should be printed on food labels and how this should be performed; sodium content, not the salt equivalent, is required to be included on food package labels under this regulation.[7] However, the target values for salt reduction are shown in grams per day in both the Dietary Reference Intakes for Japanese 2010 (DRI2010)[8] and the Guidelines for Management of Hypertension 2009 by the Japanese Hypertension Society (JSH2009).[9] It is not clear whether consumers have adequate knowledge regarding the relationship between sodium and salt (sodium chloride), nor is it known whether they can use the printed information regarding sodium content on food labels to control their own salt intake.

Shokuiku (food education) is promoted by the Food Education Basic Law enacted in 2005,[10] and the National Conference of Shokuiku has been held every year in June under the auspices of the cabinet office. We investigated the knowledge of the conversion of sodium into salt and the target values of salt intake in DRI2010 and JSH2009 using a questionnaire among visitors to the 7th National Conference of Shokuiku 2012, in Yokohama.

METHODS

The 7th National Conference of Shokuiku was held on 16 and 17 June 2012. The National Institute of Health and Nutrition set up a booth at the site and called for visitors who were at least 20 years of age to respond to a self-administered questionnaire. In this questionnaire, information regarding the following items was requested: sex, age, occupation, engagement with food education, frequency of looking at food labels, family members in their household, knowledge regarding the relationship between risk factors for cardiovascular disease and food/nutrition, understanding of sodium content

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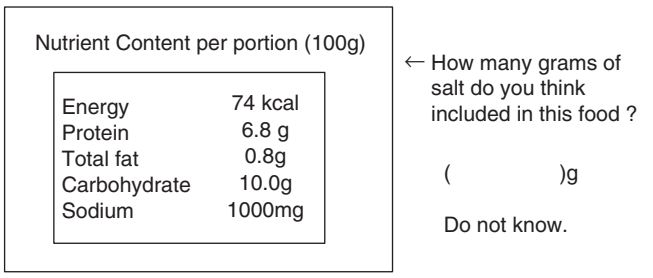

Figure 1 Question used to ask salt equivalent of 1000 mg of sodium, 7th National Conference of Shokuiku 2012, Yokohama, Japan.

Table 1 Options presented in questions asking target values in Dietary Intake Reference 2010 and Guidelines for Management of Hypertension 2009 by Japanese Society of Hypertension at the 7th National Conference of Shokuiku 2012, Yokohama, Japan

Dietary Reference Intakes 2010
Less than 12 g for men and less than 11 g for women
Less than 10 g for men and less than 9 g for women
Less than 9 g for men and less than 7.5 g for women
Guidelines for Management of Hypertension 2009
(same value for men and women)
Less than 10 g
Less than 8 g
Less than 6 g

on food labels and knowledge regarding the target values for salt intake according to DRI2010 and JSH2009.

The question regarding the understanding of food labeling is shown in Figure 1. Respondents were asked to calculate the salt equivalent of 1000 mg of sodium and fill in the space provided or to circle the text 'do not know.' Questions regarding the target values of salt intake were posed using a multiple-choice format (Table 1).

The characteristics of the respondents and their answers to the salt equivalent of 1000 mg of sodium were tabulated both by gender and for all respondents. Answers were considered to be correct if they were between 2.50 and 2.60 g; 1000 mg of sodium was equivalent to $(23.0 + 35.5)/23.0 = 2.54$ g of salt (sodium chloride), where 23.0 is the atomic weight of sodium and 35.5 is the atomic weight of chloride. The percentage of correct answers was calculated using the number of respondents who answered correctly as the numerator and all respondents as the denominator. 'All respondents' included those who responded with 'do not know' and those who provided no response to the question. The percentage was calculated by age class, living alone or with family, occupation, engagement with food education and frequency of looking at food labels.

Answers to the question regarding the target values of salt intake according to DRI2010 and JSH2009 were tallied by gender and age classes. χ^2-tests were used to compare the proportions of correct answers. SPSS software (Statistical Package for the Social Sciences, v21.0, IBM Corporation, Chicago, IL, USA) was used for all analysis. The two-tailed significance level was set at 0.05. The ethical committee of the National Institute of Health and Nutrition approved the study.

RESULTS

A total of 717 visitors answered the questionnaire, and the answers from 683 visitors were analyzed. Questionnaires were excluded if they were missing data on gender and age. The participants ranged in age from their 20s to their 70s and over, and the age ranges were almost the same for both men and women (Table 2). Fifty-eight percent of the respondents lived with their spouse and approximately one-third

Table 2 Characteristics of respondents to questionnaire at the 7th National Conference of Shokuiku, 2012, Yokohama, Japan

	Men (n = *169*)	*Women* (n = *514*)	*Total* (n = *683*)
	n *(%)*	n *(%)*	n *(%)*
Age			
20–29	17 (10.1)	80 (15.6)	97 (14.2)
30–29	30 (17.8)	85 (16.5)	115 (16.8)
40–49	29 (17.2)	102 (19.8)	131 (19.1)
50–59	36 (21.3)	100 (19.5)	136 (19.9)
60–69	38 (22.5)	90 (17.5)	128 (18.7)
70-	19 (11.2)	57 (11.1)	76 (11.1)
Live alone	29 (17.2)	73 (14.2)	120 (17.6)
Live with his/her			
Spouse	110 (65.1)	291 (56.6)	401 (58.7)
Father/mother	29 (17.2)	97 (18.9)	82 (12.0)
Brother/sister	11 (6.5)	47 (9.1)	58 (8.5)
Child(ren)	48 (28.4)	183 (35.6)	231 (33.8)
Occupation			
Medical/health care	6 (3.6)	50 (9.7)	56 (8.2)
Teacher	1 (0.6)	21 (4.1)	22 (3.2)
Clerical work/sales	26 (15.4)	51 (9.9)	77 (11.3)
Service	30 (17.8)	34 (6.6)	64 (9.4)
Manufacturering	28 (16.6)	9 (1.8)	37 (5.4)
Homemaker	8 (4.7)	210 (40.9)	218 (31.9)
Other	52 (30.8)	85 (16.5)	137 (20.1)
No response	18 (10.7)	56 (10.9)	74 (10.8)
Engaged in food education			
Yes	28 (16.7)	180 (35.0)	208 (30.4)
No	140 (82.8)	328 (63.8)	468 (68.3)
No response	1 (0.6)	8 (1.6)	9 (1.3)
Look at food labels			
Always	44 (26.0)	200 (38.9)	244 (35.6)
Frequently	56 (33.1)	211 (41.1)	267 (39.0)
Occasionally	25 (14.8)	48 (9.3)	73 (10.7)
Not so often	32 (18.9)	46 (8.9)	78 (11.4)
No	12 (7.1)	7 (1.4)	19 (2.8)
No response	0 (0.0)	4 (0.8)	4 (0.6)

lived with their children. Few respondents were engaged in medical/health-care occupations: 6 (3.6%) for men and 50 (9.7%) for women, of which 2 and 31 respondents were nutritionists, respectively. Of those 52 men who answered that their occupation was 'other,' 12 respondents wrote that they were company employees. For female respondents, 40.9% were homemakers, and of those 85 who answered 'other' for their occupation, 28 were students. For the question regarding the participants' engagement with food education, 16.7% of men and 35.0% of women answered 'yes.' For the question regarding how often they look at food labels, 59.1% of men and 80.0% of women answered that they 'always' or 'sometimes' look at them.

For the question regarding the salt equivalent of 1000 mg of sodium, 27.7% of respondents answered 'do not know' or left the answer blank (Table 3). The minimum value of the salt equivalent was 0 g (one respondent), the maximum was 1000 g (29 respondents) and the median value was 2.42 g (data not shown). Only 13.3% of respondents gave a correct answer (2.50–2.60 g): 7.7% for men and 15.2% for women.

Table 3 Distribution of answers to 'how many grams of salt do you think 1000 mg of sodium is equivalent to ?' by men and women respondents aged 20 years and over: 7th National Conference of Shokuiku 2012, Yokohama, Japan

	Men n *(%)*	*Women* n *(%)*	*Total* n *(%)*
1000 mg of sodium is equivalent to ( )g of salt			
0.00–1.00	63 (37.3)	160 (31.1)	223 (32.7)
1.01–2.00	4 (2.4)	8 (1.6)	12 (1.8)
2.01–3.00	18 (10.7)	93 (18.1)	111 (16.3)
3.01–4.00	3 (1.8)	8 (1.6)	11 (1.6)
4.01–5.00	2 (1.2)	0 (0.0)	2 (0.3)
5.01–10.00	20 (11.8)	67 (13.0)	87 (12.7)
10.01–20.00	4 (2.4)	0 (0.0)	4 (0.6)
20.01–30.00	2 (1.2)	2 (0.4)	4 (0.6)
30.01–100.00	2 (1.2)	9 (1.8)	11 (1.6)
100.01–1000.00	10 (5.9)	19 (3.7)	29 (4.2)
Answered 'do not know'	35 (20.7)	117 (22.8)	152 (22.3)
No response	6 (3.6)	31 (6.0)	37 (5.4)
Respondents who answered correctly			
2.50–2.60	13 (7.7)	78 (15.2)	91 (13.3)
Total	169 (100.0)	514 (100.0)	683 (100.0)

The percentages of those who gave a correct answer were examined across age classes, family situation, occupations and engagement with food education (Table 4). The percentage was higher for the younger group than for the elderly. It was also higher for those living alone or living with their parents than for those living with their spouse or children. The respondents engaged in medical/health-care services had a higher percentage of correct answers: 66.7% for men and 38.0% for women. The percentage of those with a correct answer among homemakers, who accounted for 40.7% of female respondents, was low at 5.2%. The percentages for those engaged in food education were 17.9% for men and 26.7% for women. Those who reported that they often looked at food labels gave a correct answer more frequently, especially for women (23.5%).

The numbers and percentages of respondents who chose a correct answer for questions regarding the target values of salt intake according to DRI2010 and JSH2009 are shown in Table 5. The percentages of those who chose a correct answer were 61.8% (52.9% for men and 67.5% for women) for DRI2010 and 40.4% (29.4% for men and 57.5% for women) for JSH2009. The percentages were higher in women than in men, and the differences among the age classes were not pronounced, except for women in their 20s having a higher percentage (57.5%) and women in their forties having a lower percentage (32.4%) for JSH2009. For DRI2010, 71.4% of medical/health-care workers, 66.5% of homemakers and 64.4% of those engaged in food education chose a correct answer, and for JSH2009, the percentages were 51.4% for medical/health-care workers, 44.0% for homemakers and 42.8% for those engaged in food education (data not shown).

DISCUSSION

We surveyed visitors to an exhibition site of a food education conference to learn about their understanding of the sodium content on food labels by giving them a questionnaire. We analyzed the answers obtained from the 683 respondents; only 13.3% of the respondents knew that 1000 mg of sodium was equivalent to 2.54 g of salt. We also used a multiple-choice format to learn about the respondents' knowledge regarding the target values of salt reduction according to DRI2010 and JSH2009. For DRI2010, 61.8% of respondents chose the correct answer (<9 g for men and <7.5 g for women), and for JSH2009, 40.4% of respondents chose the correct answer (<6.0 g for both men and women). These results show a serious gap between the high percentages of those who knew that salt intake should be restricted to a certain number of grams of salt and the low percentages of those who correctly understood the meaning of the sodium content in mg printed on food labels. Therefore, it is suggested that salt content in foods should be labeled in a way that can be easily understood by consumers so that it can be utilized effectively for salt reduction.

The answers to the question regarding the amount of salt equivalent to 1000 mg of sodium were distributed over a wide range (0 g–1000 g, Table 3). The distribution of answers suggests not only that the conversion factor of sodium to salt was not known but also that 'mg,' which is the usual unit for sodium content on food labels, seems to have confused people.

This survey was conducted at a National Shokuiku Conference site held on 2 days over a weekend, and the total number of visitors was $\sim$36 800.[11] The main visitors were families enjoying events about food education and various foods from all over Japan, and our respondents included a certain number of people engaged in food education: 16.7% of male respondents and 35.0% of female respondents; however, the percentage of those who answered correctly was low: 17.9% for men and 26.7% for women. The percentage of correct answers among homemakers, who were generally considered to be the ones who prepare meals for their families, was also low at 5.2%. The current results suggest the inadequacy of the food labeling as defined by the relevant law with regard to salt content and the lack of education regarding how people can utilize the information on food packages for the care of their own health.

Historically and culturally, the Japanese diet has been higher in salt intake than that in western countries.[1–4] In the 1960s, salt intake per day estimated from 24-h urine was as high as 26 g in Akita prefecture, an area in northeast Japan known to have an especially high salt intake.[12] Japan was among the countries with the highest prevalence of hypertension and stroke mortality in the world at that time.[12,13] A movement to reduce salt intake spread nationwide and the average salt intake has decreased gradually.[14,15] In the late 1980s, three centers in Japan were enrolled in the INTERSALT Study and the average 24-h urinary sodium at these centers was 168.3–212.4 mmol (9.8–12.4 g of salt).[16] In the late 1990s, four centers in Japan were enrolled in the INTERMAP Study, and the average 24-h urinary sodium was 211 mmol (12.3 g of salt) for men and 186 mmol (10.9 g) for women.[17] In 2009, the average salt intake in adults was 11.6 g for men and 9.9 g for women based on semi-weighted dietary records in the National Health and Nutrition Survey in Japan.[15] However, more recent salt intake estimates based on 24-h urine analyses of population samples are not available in Japan. The average salt intake is still higher in Japan than in western countries: 8.1 g in 2011 in the United Kingdom[18] and 9.8 g after 2000 in the United States,[19] both estimated from 24-h urine collections.

Health Japan 21 set basic directions for the comprehensive promotion of Japanese health; it started in 2001 with a target value for salt intake for adults set at 10 g.[20] In the final report of Health Japan 21,[21] it was evaluated that the situation of salt intake had improved, but the target had not been achieved; the average salt intake in 2009 was above the target at 10.7 g. The second edition

Table 4 Number and percentage of respondents answered correctly to a question 'how many grams of salt do you think equals to 1000 mg of sodium ?' accross characteristics of respondents, men and women aged 20 years and over: 7th National Conference of Shokuiku 2012, Yokohama, Japan

	Men		*Women*		*Total*	
	n *(%)*	P-*value*	n *(%)*	P-*value*	n *(%)*	P-*value*
Age (years)						
20–29	4 (23.5)	0.022	29 (36.3)	<0.001	33 (34.0)	<0001
30–29	2 (6.7)		16 (18.8)		18 (15.7)	
40–49	3 (10.3)		10 (9.8)		13 (9.9)	
50–59	1 (2.8)		15 (15.0)		16 (11.8)	
60–69	2 (5.3)		6 (6.7)		8 (6.3)	
70-	1 (5.3)		2 (3.5)		3 (3.9)	
Live alone	5 (17.2)	0.050	18 (24.7)	0.061	23 (19.2)	<0.010
Live with his/her (multiple answers were allowed)						
Spouse	3 (2.7)	0.002	35 (12.0)	<0.001	38 (9.5)	<0.001
Father/mother	5 (17.2)	0.050	26 (26.8)	<0.001	31 (37.8)	<0.001
Brother/sister	1 (9.1)	0.597	13 (27.7)	0.002	14 (24.1)	0.002
Child	2 (4.2)	0.229	22 (12.0)	0.048	24 (10.4)	0.037
Occupation						
Medical/health care	4 (66.7)	0.002	19 (38.0)	0.019	23 (41.1)	0.006
Teacher	0 (0.0)		6 (28.6)		6 (27.3)	
Clerical work/Sales	0 (0.0)		2 (3.9)		2 (2.6)	
Other service	1 (3.3)		3 (8.8)		4 (6.3)	
Manufacturering	1 (3.6)		1 (11.1)		2 (5.4)	
Homemaker	1 (12.5)		11 (5.2)		12 (5.5)	
Other	4 (7.5)		26 (30.6)		30 (21.9)	
No response	2 (11.1)		10 (17.9)		12 (16.2)	
Engaged in food education						
Yes	5 (17.9)	0.004	48 (26.7)	<0.001	53 (25.5)	<0.001
No	7 (5.0)		26 (7.9)		33 (7.1)	
No response	1 (100.0)		4 (50.0)		5 (55.6)	
Look at food labels						
Always	5 (11.4)	0.234	47 (23.5)	0.001	52 (21.3)	<0.001
Frequently	5 (8.9)		22 (10.4)		27 (10.1)	
Occasionally	3 (12.0)		4 (8.3)		7 (9.6)	
Not so often	0 (0.0)		2 (4.3)		2 (2.6)	
No	0 (0.0)		0 (0.0)		0 (0.0)	
No response	—		0 (0.0)		0 (0.0)	

P-values were obtained by χ^2-tests or Fisher's exact tests in cases where expected frequency was less than five.

started in 2013 and the target value for salt intake was set at 8.0 g.[22] Salt reduction is a key issue in the health promotion for individuals, food manufacturers and health professionals.[4,23–25]

The Health Promotion Act defines the order and units of nutrients to be printed on food labels as follows: 1, total energy in kcal; 2, protein in grams; 3, total fat in grams; 4, carbohydrate in grams; and 5, sodium in milligrams.[26] However, food labeling is at the discretion of manufacturers, and some manufactures indicate the salt equivalent on labels in addition to the other five nutrients listed above. In some countries, food labeling has been planned in a more strategic way. For example, in the United Kingdom where the Food Standards Agency undertook a salt reduction program, there are now front-of-pack labeling and traffic-light colors to indicate whether the salt level is 'low,' 'medium' or 'high' in terms of the percentage of the daily recommended amount to help consumers make 'at a glance' healthier choices.[25,26] These types of enhanced food labels were demonstrated to be advantageous in consumers' decisions to select low-salt foods.[26–30]

The current study had several limitations. First, the respondents to our questionnaire were limited to the attendees and the visitors to the National Conference of Shokuiku that included medical/health-care workers (8.2%) and those engaged in food education (30.4%). Among current respondents, 73.9 and 89.3% of male and female respondents, respectively, answered that they always/frequently/occasionally looked at food labels; the proportions were higher than those for similar questionnaire asked in the National Health and Nutrition Survey 2009, in which 25.0% of male participants and 55.3% of females answered that they always/occasionally looked at food labels.[21] Respondents for the current study seemed to have been more interested in food and nutrition, and therefore we cannot extrapolate the current result to the general Japanese population. Second, this is a cross-sectional study, and we did not examine the

Table 5 Number and percentage of respondents who chose the correct answer of target values of salt reduction by age classes in Dietary Reference Intakes for Japanese 2010, and Guidelines for Management of Hypertension 2009 by the Japanese Society of Hypertension, men and women aged 20 years and over: 7th National Conference of Shokuiku 2012, Yokohama, Japan

	Men (n = *169*)		*Women* (n = *516*)		*Total* (n = *685*)	
	n *(%)*	P-*value*	n *(%)*	P-*value*	n *(%)*	P-*value*
Dietary Reference Intakes for Japanese 2010						
Age (years)						
20–29	9 (52.9)	0.907	54 (67.5)	0.203	63 (64.9)	0.380
30–29	18 (60.0)		53 (62.4)		71 (61.7)	
40–49	13 (44.8)		60 (58.8)		73 (55.7)	
50–59	19 (52.8)		60 (60.0)		79 (58.1)	
60–69	20 (52.6)		65 (72.2)		85 (66.4)	
70-	9 (47.4)		42 (73.7)		51 (67.1)	
Total	88 (52.1)		334 (65.0)		422 (61.8)	
Guidelines for Management of Hypertension 2009						
Age (years)						
20–29	5 (29.4)	0.907	46 (57.5)	0.024	51 (52.6)	0.122
30–29	9 (30.0)		36 (42.4)		45 (39.1)	
40–49	12 (41.4)		33 (32.4)		45 (34.4)	
50–59	12 (33.3)		40 (40.0)		52 (38.2)	
60–69	13 (34.2)		37 (41.1)		50 (39.1)	
70-	5 (26.3)		28 (49.1)		33 (43.4)	
Total	56 (33.1)		220 (42.8)		276 (40.4)	

P-values were obtained by χ^2-tests or Fisher's exact tests in cases where expected frequency was less than five.

effect of the labeling of salt content on consumers' behavior. To the best of our knowledge, the association between the type of food label and consumers' choice of food has not been investigated in Japan. Further experimental research would be needed for effective food labels in Japan. Third, the question regarding the salt equivalent of 1000 mg of sodium could have been more practical with supplementary information such as 'this is an example of a food label for a cup of miso soup,' which may have avoided extremely high or low answers. In addition, the questions regarding the target values in DRI2010 and JSH2009 were not open-ended questions but closed-ended questions presenting options, which may have led respondents to choose the correct answers. The possible leading of the answers may have led to an overestimation of respondents who knew the target value in each guideline.

In conclusion, only 13.3% of respondents who responded to a questionnaire at a food education conference site calculated the salt equivalent of sodium correctly, which suggests the difficulty of the current food labeling regulations in Japan for obtaining good understanding by consumers. The salt content in grams, not the sodium content, should be labeled on food packages, and further investigations are needed for better nutrition labeling of salt in Japan (that is, the use of percentage of daily intake and/or the traffic-light label) to achieve effective salt reduction through consumers' better choices of foods and the prevention of hypertension.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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