



# Food items contributing to high dietary salt intake among Japanese adults in the 2012 National Health and Nutrition Survey

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Received: 4 July 2017 / Revised: 8 August 2017 / Accepted: 9 August 2017 / Published online: 15 January 2018  
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Reduction of dietary salt intake is a major public health goal to decrease the risk of hypertension and related cardiovascular disease. The WHO recommends a salt intake of less than 5 g/day [1], the latest Dietary Reference Intakes for Japanese recommends a salt intake of less than 8 g/day for adult men and 7 g/day for women [2], and The Japanese Society of Hypertension recommends less than 6 g/day for adults [3]. Dietary salt intakes of Japanese adults have steadily declined since 1995, when dietary salt intakes were 15.0 and 13.0 g/day for men and women, respectively. However, intakes still exceed official recommendations at 11.0 and 9.2 g/day for men and women, respectively, according to the 2015 National Health and Nutrition Survey, Japan [4]. According to results from prior studies using urine collections, salt intake ranges from 7.8 to 14 g/day [5–7].

Approaches to inform the public and raise awareness about salt reduction have been intensively conducted. For example, the annual report of the National Health and Nutrition Survey, Japan [4], provides a list of food groups contributing to salt intake, and “seasonings and spices” ranks the highest at more than 60% of total salt intake. Creating a healthy food environment is another effective approach for population salt reduction, and this approach includes food labeling. However, labeling alone may be insufficient for consumer decisions, as we have previously reported that food labeling with sodium content did not result in a public understanding regarding the salt content of foods [8]. Consumers aiming for salt reduction may be able to select foods more adequately when the average salt

intake is shown along with the average intake of the specific food item. To provide information on the major food items contributing to high salt intake, we re-analyzed food intake data from the 2012 National Health and Nutrition Survey.

## Materials and methods

A survey dataset of individual food intake (1,487,018 records) from the 2012 National Health and Nutrition Survey (2012 NHNS) was re-analyzed with permission from the Ministry of Health, Labour and Welfare, Japan. The 2012 NHNS dataset was chosen because the number of survey households was nearly four-times larger than that of the usual survey year. The dataset was limited to adults aged 20 or older who completed the 1-day dietary survey in 2012 ( $N = 26\,726$ ), which contained 895,494 individual records of food intake. The sodium content of individual food items was estimated by applying the Standard Food Composition Tables 2010 [9]. Dietary salt intake (g) from foods was estimated by the following equation:  $2.54 \times \text{sodium (mg)} / 1000$ . For foods categorized as “cereals”, dried seaweeds, and dried mushrooms, food weight was calculated as post-cooked weight and multiplied by the factors shown in the Standard Food Composition Tables 2010 [9]. The study population was divided into the following three age categories: 20–39 years, 40–59 years, and 60 years or older. Mean, standard deviation, median, 25th percentile and 75th percentile values for dietary salt and food intake were calculated for the day of survey for participants who consumed a specific food item, and the food item list was limited to items consumed by more than 1% of the population. To compare salt intake for increasing age categories, PROC SURVEYREGRESSION was applied because the 2012 NHNS survey households were sampled with stratified cluster-sampling. To compare the rate of consumers of a food item across age groups, the Cochran-Mantel-Haenszel test was applied. Details of the 2012 NHNS dataset have already been reported [10]. All analyses were conducted using SAS 9.4 software.

**Electronic supplementary material** The online version of this article (<https://doi.org/10.1038/s41440-017-0007-z>) contains supplementary material, which is available to authorized users.

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**Table 1** Mean dietary salt intakes by sex and age group

	Age group												p for trend <sup>a</sup>
	Total			20–39yrs			40–59yrs			60yrs+			
	N	Mean	SE	N	Mean	SE	N	Mean	SE	N	Mean	SE	
Men	12265	11.3	0.1	2793	10.8	0.1	3694	11.4	0.1	5778	11.5	0.1	<0.001
Women	14461	9.6	0.1	3112	8.9	0.1	4364	9.6	0.1	6985	10.0	0.1	<0.001
Total	26726	10.4	0.1	5905	9.8	0.1	8058	10.4	0.1	12763	10.7	0.1	<0.001

<sup>a</sup> according to age category**Table 2** Food items contributing to top 20 salt intakes among adult Japanese

Food item <sup>a</sup>	Item No.	All (N = 26726)			20–39 years (N = 5905)			40–59 years (N = 8058)			> =60 years (N = 12763)			p for trend in age group, rate of consumers <sup>b</sup>
		Rate of consumers, %	Salt intake (g) per day (SD)	Rate of consumers, %	Salt intake (g) per day (SD)	Rate of consumers, %	Salt intake (g) per day (SD)	Rate of consumers, %	Salt intake (g) per day (SD)	Rate of consumers, %	Salt intake (g) per day (SD)			
Common wheat, instant Chinese noodles, dried by frying, seasoned	1056	1.0	5.5 (2.0)	1.3	5.4 (2.1)	1.1	5.6 (2.1)	0.9	5.4 (1.7)	0.01				
Roux, Japanese curry roux, instant	17051	9.5	2.7 (1.7)	11.8	2.8 (1.8)	10.9	2.8 (1.9)	7.5	2.5 (1.5)	<0.01				
Soy sauce, "Koikuchi-shoyu" (common soy sauce)	17007	82.1	2.2 (1.9)	79.9	2.0 (1.7)	82.0	2.1 (1.8)	83.4	2.4 (1.9)	<0.01				
Cucumber, fruit, pickles, "Nukamiso-zuke" (pickled in salty rice bran paste)	6068	1.7	2.0 (1.6)	0.6	1.7 (1.1)	1.1	1.8 (1.3)	2.6	2.2 (1.6)	<0.01				
Mume*, "Umeboshi" (pickled and dried mume), salted pickles [*Syn. Japanese apricots]	7022	9.3	1.9 (1.4)	7.0	1.7 (1.2)	9.0	1.8 (1.3)	10.5	2.0 (1.5)	<0.01				

Table 2 (continued)

Food item <sup>a</sup>	Item No.	All (N = 26726)		20–39 years (N = 5905)		40–59 years (N = 8058)		> =60 years (N = 12763)		p for trend in age group, rate of consumers <sup>b</sup>
		Rate of consumers, %	Salt intake (g) per day Mean (SD)	Rate of consumers, %	Salt intake (g) per day Mean (SD)	Rate of consumers, %	Salt intake (g) per day Mean (SD)	Rate of consumers, %	Salt intake (g) per day Mean (SD)	
Miso, rice-koji miso, light yellow type	17045	47.1	1.9 (1.3)	41.0	1.7 (1.1)	45.8	1.8 (1.2)	50.8	2.0 (1.4)	<0.01
Miso, rice-koji miso, red type	17046	14.5	1.8 (1.3)	12.2	1.6 (1.1)	13.8	1.6 (1.1)	16.0	1.9 (1.4)	<0.01
Soy sauce, "Usukuehi-shoyu" (light color soy sauce)	17008	13.1	1.6 (1.5)	9.8	1.7 (1.7)	11.9	1.4 (1.4)	15.4	1.7 (1.6)	<0.01
Miso, instant miso soup, Paste type	17050	4.2	1.6 (0.9)	4.1	1.6 (0.9)	4.4	1.6 (0.8)	4.1	1.6 (0.9)	0.75
Edible salt, common salt, sodium chloride $\geq$ 99%	17012	81.4	1.6 (1.5)	86.6	1.7 (1.6)	85.0	1.6 (1.5)	77.0	1.5 (1.4)	<0.01
Miso, barley-koji miso	17047	8.7	1.5 (1.1)	6.7	1.4 (1.1)	7.9	1.4 (1.1)	10.3	1.6 (1.2)	<0.01
Miso, soybean-koji miso	17048	1.4	1.4 (1.0)	1.2	1.3 (0.8)	1.3	1.4 (1.1)	1.5	1.5 (1.0)	0.12
Leaf mustard, "Takana", leaves, salted pickles	6148	1.3	1.2 (1.0)	1.1	1.0 (0.8)	1.1	1.1 (0.8)	1.5	1.4 (1.2)	0.01
Edible salt, refined salt, sodium chloride $\geq$ 99.5%, containing magnesium carbonate	17014	1.5	1.2 (1.4)	1.1	1.2 (1.4)	1.7	1.2 (1.5)	1.5	1.2 (1.3)	0.06
Japanese noodle soup, triple-concentrated (soy sauce base)	17030	25.6	1.2 (1.5)	22.0	1.1 (1.5)	23.7	1.2 (1.7)	28.5	1.2 (1.5)	<0.01
Fish, Atka mackerel*, "Hirakiboshi" (mild salted and semi-dried split), raw [*Syn. Arabesque greenling]	10248	1.0	1.2 (0.7)	0.8	1.1 (0.9)	0.9	1.1 (0.6)	1.1	1.2 (0.7)	0.035
Fish, cod, walleye pollock*, "Karashi-mentaiko" (salted roe with red hot pepper powder) [*Syn. Alaska pollock]	10204	2.1	1.1 (1.1)	2.3	1.1 (1.1)	2.3	1.1 (1.0)	1.9	1.2 (1.2)	0.0582
Fish, mackerel, processed products, "Shiosaba" (plain salted fillet)	10161	2.9	1.1 (0.6)	2.3	1.0 (0.6)	2.7	1.0 (0.5)	3.4	1.1 (0.6)	<0.01
Japanese noodle soup, non-concentrated (soy sauce base)	17029	13.5	1.1 (1.8)	11.9	1.0 (1.7)	13.3	1.0 (1.7)	14.3	1.2 (1.9)	<0.01
Chinese cabbage, head, pickles, salted pickles	6235	4.9	1.0 (1.0)	1.6	0.8 (0.7)	3.4	0.9 (1.0)	7.4	1.1 (1.1)	<0.01

<sup>a</sup> Selected from 336 food items with more than 266 consumers (1% <= of the total population)

<sup>b</sup> Cochran-Mantel-Haenszel test

## Results

As shown in Table 1, the mean salt intake increased significantly with advancing age categories in men, women, and the total adult population. In Table 2, food items contributing to the top 20 salt intake sources of Japanese adults are listed in descending order of the mean salt intake of consumers. With the exception of instant Chinese noodles, Japanese curry roux and edible salt, these food items were mostly traditional Japanese foods, such as miso and soy sauce. The rate of consumers of traditional seasonings among adults <60 years was lower compared to that of the highest age group; for example, the percentage of adults consuming “miso, rice-koji miso, light yellow type” was 41.0, 45.8, and 50.8% for 20–39 years, 40–59 years, and 60+ years ( $p < 0.01$ ), respectively. The rate of consumers of instant Chinese noodles and Japanese curry roux was higher among the younger age groups ( $p = 0.01$  and  $< 0.01$ , respectively). The total list of frequently consumed food items (consumed by 1% or more of the total adult population) is provided in the Supplementary information.

## Discussion

Through re-analyses of dietary record data from the 2012 NHNS, we were able to select the major food items contributing to salt intake among the Japanese population. Our results from the one-day survey were similar to a recent study applying detailed 4-day dietary records and two 24-h urine collections [11] conducted on 392 Japanese adults aged 20–69 years. The present results provide further detailed information regarding food items contributing to the salt intake of Japanese adults. According to the recent dietary intervention conducted on Japanese adults with high-normal blood pressure and stage 1 hypertension, after 2 months of undergoing a low-salt diet of 8 g/day, their salt intakes resumed to pre-intervention levels at 4 months post-intervention [12]. This result suggests the difficulty of adhering to a low-salt diet without providing practical advice for selecting low-salt foods. We hope that our study results will help people aiming to reduce salt intake and food manufacturers making efforts to produce low-salt foods.

**Acknowledgements** This study was supported by the Health Japan 21 (the second term) Analysis and Assessment Project, Ministry of Health, Labour, and Welfare.

## Compliance with ethical standards

**Conflict of interest** The authors declare that they have no conflict of interest.

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