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Nutrition knowledge related to breakfast skipping among Japanese adults aged 18–64 years: a cross-sectional study

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Abstract

Objective: Breakfast skipping is regarded as a public health issue among adults worldwide. Nutrition knowledge has been reported to be one of predictors of dietary behaviour. Therefore, the aim of the present study was to examine the association between nutrition knowledge and breakfast skipping.
Design: Data regarding nutrition knowledge were obtained by using a validated, self-administered general nutrition knowledge questionnaire for Japanese adults (JGNKQ). Participants were classified into three nutrition knowledge level groups according to total JGNKQ score: Low, Middle and High. In addition, participants reported the frequency of meal consumption per week and rated the difficulty in finding time to eat breakfast, lunch and dinner in the lifestyle questionnaire. The differences in frequency of breakfast, lunch and dinner consumption among Low, Middle and High nutrition knowledge groups were determined by using ANCOVA adjusted for potential confounding factors.
Setting: Kanto region, Japan.
Participants: Japanese adults aged 18–64 years (*n* 1165, 57·3 % women).
Results: Mean age of the participants was 43·8 (SD 8·9) years. There were no significant differences found in the proportion of respondents reporting difficulty in finding time to eat each meal among the three groups. However, the frequency of breakfast consumption was significantly different among Low, Middle and High groups, while lunch and dinner frequency did not differ among the three groups.
Conclusions: The present study suggests that nutrition knowledge level is related to breakfast skipping among Japanese adults.

Keywords
Nutrition knowledge
Breakfast skipping
Adults
Japan

Eating behaviours can be influenced by various factors. Nutrition knowledge has been reported to affect eating behaviours of adults[1,2]. Several studies have reported that people with higher nutrition knowledge level practise better dietary behaviours such as higher consumption of vegetables, fruits, fibre and micronutrients and less fat than those with lower nutrition knowledge level[2–6]. Additionally, one study has suggested that nutrition knowledge is one of the factors necessary to improve dietary behaviours[7]. For example, it has been reported that adults with knowledge about dietary fat and cholesterol effectively improved those nutrients' intake[8]. Thus, nutrition knowledge may lead to appropriate dietary behaviours.

Eating breakfast has been reported as a predictor of healthy eating behaviours such as high intake of dietary fibre, thiamin or folate and low intake of fat in previous cross-sectional and intervention studies[9–11]. In addition, it has been reported that breakfast skipping affects individuals' health status. For example, breakfast skipping was reported to be associated with weight gain[12,13] and increase of BMI[14,15]. Moreover, breakfast skipping was reported to be associated with higher prevalence of obesity[13], hypertension[16,17], hyperlipidaemia[17,18], insulin insensitivity and type 2 diabetes[13], and CVD[17,19]. Thus, breakfast skipping is likely to lead to a worse health condition. The rate of breakfast skipping among Japanese adults has not decreased over the past 10 years[20]. Similarly, breakfast skipping has been reported as a public health issue all over the world including among US[21] and UK adults[22]. Therefore, efforts to improve the behaviour of breakfast skipping are required after clarifying the factors related to breakfast skipping throughout the world.

Breakfast skipping may be improved by nutrition knowledge. However, there are only a few studies that have examined the relationship between breakfast skipping and nutrition knowledge. According to a previous

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study, it was indicated that people with lower nutrition knowledge level tended to skip breakfast[23]. However, that study examined a limited area of nutrition knowledge using a questionnaire that included only eight question items derived from the General Nutrition Knowledge Questionnaire (GNKQ) comprising 110 questions[24]. Thus, the relationship between breakfast skipping and nutrition knowledge has not been completely clarified yet. To investigate the association between breakfast skipping and nutrition knowledge, it is needed to study the breakfast skipping–nutrition knowledge relationship using an overall general nutrition knowledge questionnaire that has reasonable validity and reliability. Therefore, the aim of the present study was to evaluate the association of breakfast skipping and overall nutrition knowledge level.

Methods

Procedure and study population

Japanese adults aged 18–64 years were recruited from students' parents or acquaintances through seven kindergartens, one elementary school, two junior high schools, two high schools and one university in Tokyo, Chiba and Ibaraki prefectures, Kanto region, Japan, from January to March 2015. A set of two self-administered questionnaires (i.e. a Japanese general nutrition knowledge questionnaire (JGNKQ) and a lifestyle questionnaire) was distributed to a total of 5418 Japanese adults (2709 men and 2709 women) aged 18 to 64 years. The completed questionnaires which were collected by mail were examined by the research staff, and those with missing information were returned to the participants for completion. Both questionnaires were completed by 1281 Japanese adults (response rate: 23·6 %).

We excluded the following respondents: those who had missing data (n 98), those who reported age under 18 years or over 65 years (n 7) and those who were receiving nutritional counselling by a doctor or registered dietitian (n 11). Thus, the final participant list consisted of 1165 Japanese adults. Written informed consent was obtained from all participants.

Assessment of nutrition knowledge level

Nutrition knowledge level was assessed using a previously validated Japanese general nutrition knowledge questionnaire (JGNKQ)[25]. Details of the JGNKQ's structure, validity and reliability have been published elsewhere[25]. Briefly, the JGNKQ is a self-administered ten-page questionnaire including five sections, i.e. 'Dietary recommendations' (section 1; nine items), 'Sources of nutrients' (section 2; ninety-six items), 'Choosing everyday foods' (section 3; five items), 'Diet–disease relationships' (section 4; twenty items) and 'Reading a food label' (section 5; seventeen items), with a total of 147 items.

The responses were converted to binary numbers, with 1 and 0 representing correct and incorrect answers, respectively. Therefore, the maximum score on the 147-item questionnaire was 147 points. A higher score reflects a higher knowledge level. In the current study, we classified participants into three nutrition knowledge level groups according to the JGNKQ total score: Low, Middle and High.

Frequency of meals and difficulty of the behaviour having time to sit down and eat

Participants reported difficulty of the behaviour having time to sit down and eat at breakfast, lunch and dinner and the frequency of breakfast, lunch and dinner per week in the lifestyle questionnaire, by asking, 'Is it usually difficult to sit down and eat for you at breakfast, lunch and dinner, respectively?' and 'How many times per week do you have breakfast, lunch and dinner, respectively? The definition of breakfast was the first meal of the day, eaten before or at the start of daily activities (e.g. errands, travel, work), within 2 h of waking, typically no later than 10.00 hours, and of energy level between 20 and 35 % of total daily energy needs, which is defined by Timlin and Pereira[26]. Due to the lack of any standard definition of lunch and dinner time in the literature, we defined that lunch and dinner were the meals eaten from 12.00 to 14.00 hours and from 16.00 to 20.00 hours, respectively. Difficulty of the behaviour having time to sit down and eat was asked of participants using a 5-point Likert scale ('very difficult', 'difficult', 'in between', 'easy', 'very easy').

Other variables

In the lifestyle questionnaire, the participants reported their sex, age, educational background (junior high school or high school; junior college or vocational technical school; university or higher), annual household income (<2 million yen; 2–6 million yen; 6–10 million yen; >10 million yen), working status (full-time; part-time; housewife; student; others); marital status (yes; no) and number of children (0; 1; 2; ≥3).

Statistical analysis

All statistical analyses were performed using the statistical software package IBM SPSS Statistics version 22.0. All reported P values are two-tailed, with $P < 0{\cdot}05$ considered statistically significant. The differences in characteristics between Low, Middle and High groups were compared using the χ^2 test for categorical variables and ANOVA for continuous variables. The proportions of difficulty of the behaviour having time to sit down and eat were compared by the χ^2 test among Low, Middle and High groups.

Additionally, multivariate-adjusted means with SE for meal frequency per week were calculated among Japanese adults categorized into Low, Middle and High groups,

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respectively. Potential confounding factors considered in the first analysis were sex, working status and number of children, which were found to be significantly different ($P<0·05$) between groups categorized by nutrition knowledge level. Then, the confounding factors in the second analysis were the first model factors and age, which was reported as a factor affecting breakfast skipping among Japanese[15,27]. The adjusted differences in frequency of breakfast, lunch and dinner between Low, Middle and High groups were assessed by ANCOVA.

Results

Basic characteristics of participants are shown in Table 1. The proportion of women was 57·3 %, and the mean age of the study participants was 43·8 (SD 8·9) years. The main characteristics of participants were having a university degree (41·5 %), having an annual income of 6–10 million yen (42·1 %) and being employed full-time (45·8 %). Additionally, the mean total nutrition knowledge score of all participants was 69·3 (SD 23·7). Significantly more female participants were categorized into the High nutrition knowledge group than the Low nutrition knowledge group ($P<0·001$). Compared with participants in the High group, those in the Low group had a higher proportion of full-time workers and a lower proportion of housewives ($P<0·001$). Significantly more participants with a child were categorized into the High group than the Low and Middle groups ($P=0·002$). There were no significant differences in age, education, annual household income and marital status among participants categorized in Low, Middle and High groups.

The proportions of difficulty of the behaviour having time to sit down and eat at breakfast, lunch and dinner in the Low, Middle and High groups are shown in Table 2. The percentage of those who answered 'very difficult' or 'difficult' to the question 'Is it usually difficult to sit down and eat for you at breakfast, lunch and dinner, respectively?' was less than 7, 5 and 4 %, respectively, in all groups. Additionally, no significant differences were observed in the proportions of the difficulty of having time to sit down and eat at breakfast, lunch and dinner according to nutrition knowledge level.

Table 3 shows the frequency of breakfast, lunch and dinner per week among participants who were categorized in the Low, Middle and High groups. The mean number of days of eating breakfast was 5·3 (SE 0·1) in the Low group, 5·6 (SE 0·1) in the Middle group and 5·7 (SE 0·1) in the High group. The mean number of days of lunch or dinner consumption was more than 6·0, and the number of days of lunch or dinner skipping was less than that of breakfast in all groups. The breakfast frequency was significantly different between Low, Middle and High groups after adjusting for sex (men or women), working status (full-time, part-time, housewife, student or other) and number of children (0, 1, 2 or ≥3; $P=0·038$), while the frequency of lunch and dinner was not different between the three groups after adjusting for sex (men or women), working status (full-time, part-time, housewife, student or other) and number of children (0, 1, 2 or ≥3). Furthermore, the results were the same when age was added to the adjusting factors, namely when adjusting for age, sex (men or women), working status (full-time, part-time, housewife, student or other) and number of children (0, 1, 2 or ≥3).

Discussion

The present study aimed to evaluate the association of breakfast skipping with nutrition knowledge level. We found that the frequency of breakfast consumption was higher in participants with high nutrition knowledge than in those with low. This finding suggests that nutrition knowledge level affects breakfast skipping among Japanese adults. To the best of our knowledge, the present study is the first not only to explore nutrition knowledge level in Japanese adults but also to examine the relationship of breakfast skipping and overall nutrition knowledge level among adults anywhere in the world.

It was reported that nutrition knowledge needs to be assessed by questionnaires with reasonable validity and reliability when assessing dietary behaviours, because it is one of the factors which influences dietary behaviours[28]. Thus, the research focusing on nutrition knowledge has been increasing. A few studies have reported that nutrition knowledge of adults assessed by a valid and reliable nutrition knowledge questionnaire is related to demographic characteristics of the participants[3,29–31]. For example, an Australian study reported that sex, age, highest level of education and employment status affected nutrition knowledge level[29]. A UK study reported that sex, educational level and socio-economic status were the factors affecting nutrition knowledge[31]. In a study on Australian military personnel, sex, age and educational background had positive relationships with nutrition knowledge[30]. Moreover, age, education level and working status were reported to affect nutrition knowledge in a study on young and middle-aged Belgian women[3]. Meanwhile, the present study found that participants' nutrition knowledge was related to the characteristics of sex, working status and number of children. Female adults had higher nutrition knowledge than male adults in the present study, similarly as previous studies[29–31]. Regarding working status, our result was slightly incoherent with previous studies[29,31] in that full-time workers were more categorized and housewives were less categorized into the group with low nutrition knowledge level. Most housewives were women (data not shown) and women had more nutrition knowledge than men[29,31]. This might explain that housewives were less categorized into the

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Table 1 Characteristics of 1165 Japanese adults aged 18–64 years categorized into Low, Middle and High groups by nutrition knowledge level, Kanto region, Japan, January–March 2015

	All (*n* 1165)		Low (*n* 392)		Middle (*n* 397)		High (*n* 376)		
	n or Mean	% or SD	*n* or Mean	% or SD	*n* or Mean	% or SD	*n* or Mean	% or SD	*P**
Sex, *n* and %									<0·001
Men	498	42·7	214	54·6	164	41·3	120	31·9	
Women	667	57·3	178	45·4	233	58·7	256	68·1	
Age (years), mean and SD	43·8	8·9	44·1	9·0	43·0	9·8	44·4	7·8	0·054
Education, *n* and %									0·093
University or higher	483	41·5	158	40·3	154	38·8	171	45·5	
Junior college or vocational technical school	352	30·2	109	27·8	128	32·2	115	30·6	
High school or junior high school	330	28·3	125	31·9	115	29·0	90	23·9	
Annual household income, *n* and %									0·053
<2 million yen	37	3·2	13	3·3	13	3·3	11	2·9	
2–6 million yen	307	26·4	103	26·3	121	30·5	83	22·1	
6–10 million yen	490	42·1	177	45·2	158	39·8	155	41·2	
>10 million yen	331	28·4	99	25·3	105	26·4	127	33·8	
Working status, *n* and %									<0·001
Full-time	534	45·8	209	53·3	177	44·6	148	39·4	
Part-time	185	15·9	60	15·3	55	13·9	70	18·6	
Housewife	283	24·3	66	16·8	108	27·2	109	29·0	
Student	60	5·2	20	5·1	26	6·5	14	3·7	
Others	103	8·8	37	9·4	31	7·8	35	9·3	
Marital status, *n* and %									0·157
Single	122	10·5	35	8·9	51	12·8	36	9·6	
Married	1043	89·5	357	91·1	346	87·2	340	90·4	
Number of children, *n* and %									0·002
0	86	7·4	25	6·4	40	10·1	21	5·6	
1	251	21·5	75	19·1	80	20·2	96	25·5	
2	599	51·4	221	56·4	181	45·6	197	52·4	
≥3	229	19·7	71	18·1	96	24·2	62	16·5	
JGNKQ score, mean and SD	69·3	23·7	42·0	14·2	72·3	6·4	94·4	8·7	<0·001

JGNKQ, general nutrition knowledge questionnaire for Japanese adults.
*Means for continuous values were compared by ANOVA and proportions for categorical values were compared by the χ^2 test between Low, Middle and High groups.

Table 2 Difficulty of the behaviour having time to sit down and eat among 1165 Japanese adults aged 18–64 years categorized into Low, Middle and High groups by nutrition knowledge level, Kanto region, Japan, January–March 2015

	Low (*n* 392)		Middle (*n* 397)		High (*n* 376)		
	n	%	*n*	%	*n*	%	*P**
Breakfast							0·288
Very difficult	27	6·9	15	3·8	14	3·7	
Difficult	36	9·2	46	11·6	51	13·6	
In between	28	7·1	31	7·8	22	5·9	
Easy	62	15·8	64	16·1	61	16·2	
Very easy	239	61·0	241	60·7	228	60·6	
Lunch							0·995
Very difficult	2	0·5	3	0·8	2	0·5	
Difficult	17	4·3	17	4·3	16	4·3	
In between	24	6·1	28	7·1	25	6·6	
Easy	78	19·9	72	18·1	65	17·3	
Very easy	271	69·1	277	69·8	268	71·3	
Dinner							0·569
Very difficult	5	1·3	2	0·5	1	0·3	
Difficult	7	1·8	13	3·3	9	2·4	
In between	14	3·6	17	4·3	12	3·2	
Easy	56	14·3	66	16·6	58	15·4	
Very easy	310	79·1	299	75·3	296	78·7	

*Proportions for categorical values were compared by the χ^2 test between Low, Middle and High groups.

Table 3 Meal frequency per week among 1165 Japanese adults aged 18–64 years categorized into Low, Middle and High groups by nutrition knowledge level, Kanto region, Japan, January–March 2015

	Low (*n* 392)		Middle (*n* 397)		High (*n* 376)			
	Mean	SE	Mean	SE	Mean	SE	*P**	*P*†
Breakfast	5·3	0·1	5·6	0·1	5·7	0·1	0·038	0·047
Lunch	6·1	0·1	6·4	0·1	6·3	0·1	0·064	0·067
Dinner	6·0	0·1	6·2	0·1	6·2	0·1	0·342	0·370

*Means for continuous values were compared by ANCOVA between Low, Middle and High groups adjusted sex (men or women), working status (full-time, part-time, housewife, student or other) and number of children (0, 1, 2 or ≥3).
†Means for continuous values were compared by ANCOVA between Low, Middle and High groups adjusted sex (men or women), working status (full-time, part-time, housewife, student or other), number of children (0, 1, 2 or ≥3) and age.

Low group in the present study. Our study classified employed status as part-time workers separately from full-time workers, but the Australian study categorized full-time workers and part-time workers into employed, and housewives were defined independently in our study although the Australian study categorized them into others[29]. Also, the UK study did not assess the relationship between working status and nutrition knowledge, and employment status was defined as socio-economic status combined with household income[31]. This result might be influenced because working status classification in the present study was different from other studies. However, more detailed classification of working status was used in present study, thus the relationship between nutrition knowledge and working status might reveal more than before.

Nutrition knowledge level differed according to number of children in the present study, as well as in the Australian study[29] and the study on young and middle-aged Belgian women[3], in contrast to the UK study[31]. However, our results were not totally consistent with these Australian and Belgian studies. The participants' nutrition knowledge level was not influenced depending on the presence of children in the current study, while the presence of children affected the adults' nutrition knowledge level in the two previous studies[3,29]. One possible reason for this could be that the age of participants was different between studies. The Belgian women had a median age of 30 years[3] and 40 % of the participants were younger than 35 years old in the Australian study, ranging from 18 to 74 years[29]. Additionally, more than 20 % of elderly people over 65 years old were included in a UK study[31], while the mean age of the participants in present study was 43·8 (SD 8·9) years. Thus, these differences in the age composition of participants between studies may have produced our result that age did not affect nutrition knowledge levels unlike the other four studies[3,29–31].

Previous studies found that education was related to nutrition knowledge[3,29–31], while those relationships were not seen in the present study. In the UK study, more than 40 % of participants were categorized into the lowest education level[31], and the Belgian and Australian military personnel studies used the classification of high or low

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education[3,29]. Only the Australian study used the same classification for education level as our study, but more than 50 % of the participants were in the lowest category; completed high school or less[29]. The difference in distribution of education background might influence the difference in results between the three previous studies and the present one.

Breakfast skipping frequency among the participants in the present study was more frequent than lunch or dinner skipping, as reported in a previous study investigating breakfast, lunch and dinner frequency among US young adults[32]. However, each meal skipping frequency in the current study was less than in the previous study. It has been reported that older people have more meal frequency[33]. In fact, the younger participants had less breakfast and lunch frequency than the older in the present study although the frequency of dinner was not different by age (data not shown). Therefore, these frequency differences might be influenced because the present study participants were older than the previous study participants.

Nutrition knowledge level was related only to breakfast skipping but not lunch and dinner skipping after adjusting for sex, working status, number of children and age in the present study. The participants who had less nutrition knowledge tended to skip breakfast frequently. This result is well consistent with the study suggesting that nutrition knowledge is necessary to improve eating behaviours[7]. A previous study also reported that participants with lower nutrition knowledge tended to miss their breakfast, although the previous study participants differed from those of the present study in terms of younger age and living in socio-economically disadvantaged neighbourhoods, and their nutrition knowledge level was measured by only part of the GNKQ[23]. Younger age and lower income were reported to have a large influence on breakfast skipping[27]. Apart from the difference in age and income status in the studies, the consistent results may indicate that nutrition knowledge is likely to be one of the factors affecting breakfast skipping.

The difference in mean breakfast frequency between High and Low groups was only 0·4 d/week. One reason for this relatively small difference might be that Japan has a lower rate of breakfast skipping compared with Western countries, although it is difficult to compare in exactly the same way due to differences in the definition of breakfast skipping in each study[11,14,15,34]. Even with a relatively small difference in breakfast frequency, nutrition education leading to a situation with less breakfast skipping is necessary, because it has been reported that breakfast skipping is related to low intakes of micronutrients[34] and other unhealthy eating behaviours[35]. Therefore, the present results may suggest there is a possibility that nutrition knowledge needs to be one of the targets when conducting nutrition education.

A systematic review of studies about breakfast skipping reported that the main factors for breakfast skipping were having no time for breakfast in the morning and habituation[36]. In the present study, the difficulty of having time to sit down and eat each meal was not significantly different according to nutrition knowledge level. Moreover, the rate of those who answered 'difficult' or 'very difficult' was low in all three nutrition knowledge groups. Thus, it is unlikely that having no time in the morning led to breakfast skipping in our study participants. Also, it has been reported that the dietary habits formed until adolescence persist throughout adult life and these behaviours can be difficult to modify later in life[37–41]. Therefore, it is impossible to deny the likelihood that the participants of the present study skipped breakfast by custom from the time of their childhood. Unfortunately, in the present study, we did not examine previous dietary habits such as those of their childhood. Further studies are needed to examine the influence of previous dietary habits on breakfast skipping in addition to nutrition knowledge.

Several limitations of the current study need to be mentioned. First, the participants in the study were not random samples from the general population and the survey area was restricted to a single region in Japan. The participants were therefore likely not representative of Japanese adults. Second, the response rate was as low as 23·6 %. The nutrition knowledge questionnaire used in the present study consists of ten pages, and it takes 20 to 30 min to answer. More than half of the participants were working, so they might not have had enough time to respond to the questionnaire. Thus, the participants might have been highly health conscious and have higher nutrition knowledge level than Japanese people. Even though the study participants were probably interested in nutrition and food, the JGNKQ scores between the three groups categorized by nutrition knowledge level were significantly different. Therefore, it may not be a problem in this research. Third, lunch was defined as consumed between 12.00 and 14.00 hours and dinner as consumed between 16.00 and 20.00 hours. If participants had lunch or dinner outside the time specified, the number of lunch or dinner was counted as zero times. Thus, there is undeniably a possibility that those factors may affect the present study results. However, Yokoyama *et al.* reported that dinner time was classified as regular time from 17.00 to 20.00 hours and irregular time other than that[27]. Additionally, traditional meal time periods reported are that breakfast is from 06.00 to 10.00 hours, lunch is from 12.00 to 14.00 hours and dinner is from 16.00 to 20.00 hours, although reported in Sweden[42]. All the average frequencies of lunch and dinner exceeded 6 d/week among participants in the present study. Thus, the definition of lunch and dinner time may not be a problem. Fourth, women with smoking habits were reported to tend to skip breakfast[23]. We did not examine the smoking status in our study. The proportion of Japanese women with smoking habits was reported as 8·2 %, a low percentage compared with other countries[20,43]. However,

it is undeniable that those factors of the home environment may affect dietary behaviour. We suggest that further investigational approaches are required to clarify these uncertainties. Finally, there could be other confounding factors than those we examined. For example, some of the participants in the present study may have worked shifts. It was reported that the proportion of shift workers is about 10 % in Japan[44]. However, it was impossible to distinguish about the aspect of shift workers with the item of 'working status'. Therefore, the effect on the results from such factors could not be ruled out.

Conclusions

The present cross-sectional study showed that nutrition knowledge level is related to breakfast skipping among Japanese adults. Thus, there may be a possibility that breakfast skipping has occurred because of little information about food and nutrition. Therefore, health-promotion programmes or nutrition counselling on breakfast skipping might need to pay greater attention to nutrition knowledge level as well as dietary habits. Further studies are needed to clarify the association between breakfast skipping and nutrition knowledge and other factors related to skipping breakfast, to make a strategy for improving dietary behaviours among adults.

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