Vegetable Intake at Breakfast and Associated Factors among Young Adults in Japan

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Summary
In Japan, the amount of vegetable intake in young adults, especially at breakfast, is low. We aimed to examine the factors associated with vegetable intake at breakfast among young adults. In 2016, a self-administered questionnaire survey was conducted at a Japanese university. The questionnaire measured the frequency of $\geq 70$ g vegetable intake at breakfast, lifestyle, eating habits, environmental factors, knowledge and attitudes (including the variable “Perceived behavior control (PBC)”, from the Theory of Planned Behavior). The data of 1,455 male students who usually ate breakfast were analyzed. They were divided into two groups based on the median of the frequency of vegetable intake and the above factors were compared using a chi-squared test by living condition. The significant factors were subsequently entered into a logistic regression analysis as independent variables. Eating breakfast with family or friends and PBC were positively associated with vegetable intake in students living with their family. Often doing one’s own cooking, having knowledge about a well-balanced diet, and PBC were positively associated with vegetable intake in students living alone. Along with PBC, different factors pertaining to an individual’s living condition may need to be considered to increase vegetable intake at breakfast.

Key Words vegetable intake, university students, breakfast, perceived behavior control, lifestyle

It has been reported that vegetable intake reduces the risk of all-cause mortality (1, 2), cardiovascular disease (1, 2), coronary heart disease (2), stroke (2), and total cancer (2). However, according to the National Health and Nutrition Survey in 2017, the amount of vegetable intake in young adults is low, an average 264.9 g/d for males and 218.4 g/d for females in their 20 s (3). These intakes are almost 100 g less than the optimum vegetable intake (350 g/d) recommended by the National Health Promotion Movement in the 21st century (Health Japan 21). A previous study reported that more than 50% of Japanese university students ate vegetables less than 2 times/wk at breakfast (4). On the other hand, 20% of the students ate vegetables less than 2 times/wk at lunch and a single-digit level at dinner (4). These results suggest that university students eat fewer vegetables at breakfast than at lunch or dinner. Thus, increasing vegetable intake at breakfast is key to increasing total vegetable intake.

Many studies in Western countries have examined the factors associated with vegetable intake. A previous review including 35 studies indicated that self-efficacy, social support, and knowledge are the predictors of adult vegetable and fruit intake (5). On the other hand, studies regarding the predictors of vegetable intake in Japan are limited. A study with 384 Japanese subjects aged 30–59 y suggested that the following factors were positively associated with $\geq 300$ g vegetable intake: 2 or more meals per day including grain, vegetables, fish and meat dishes (in both sexes), self-efficacy in consuming vegetables, the belief that vegetable intake prevents obesity, support from family or surroundings (in males), and nutrition knowledge about the appropriate amount of diet and balance (in females) (6). Another study of 395 Japanese workers aged 20–69 y indicated that the scores of self-efficacy, social support, and knowledge were positively associated with vegetable intake (7). Furthermore, a study of 2308 adults aged 18 y or older reported that higher self-efficacy was associated with more vegetable intake. However, there was no significant association between social support and vegetable intake (8). In addition to these inconsistencies, few studies have focused on vegetable intake at breakfast. Therefore, in the current study, we aimed to examine the factors associated with vegetable intake at breakfast among young adults.

MATERIALS AND METHODS

A self-administered questionnaire survey was conducted at a university in Japan. The questionnaire was distributed to a total of 3,254 Japanese male and female students of sophomore, junior and senior levels, from April to June in 2016. Among them, 2,816 students answered the questionnaire (response rate: 86.5%).
Written information was provided to each student, which included the purpose of the study, the right to refuse participation, and assurance of the security of personal information. Only students who agreed to participate in the study completed the questionnaire. The study protocol was approved by the ethics committee of the Kanagawa Institute of Technology (#20160413-001).

Items of the questionnaire

Frequency of vegetable intake at breakfast. A frequency of ≥70 g vegetable intake at breakfast during the past one month was asked in the questionnaire. Amount of 70 g is one serving size of vegetable dishes in the Japanese Food Guide Spinning Top (9).

Demographic characteristics, lifestyle, eating habits, environmental factors, knowledge, and attitudes. Along with the sex, faculty and year, the students were asked about the following items: 1) living arrangement (living alone, living with family), 2) smoking status (never smoked, smokes sometimes, smokes every day), 3) sleep duration (<5 h, 5 to <6 h, 6 to <7 h, 7 to <8 h, 8 to <9 h, ≥9 h), 4) subjective sleep satisfaction (sufficient sleep, nearly sufficient sleep, often has insufficient sleep, and insufficient sleep), 5) frequency of alcohol intake (every day, 5–6 d/wk, 3–4 d/wk, 1–2 d/wk, 1–3 d/mo, drank alcohol in the past but no alcohol consumed for over a year, rarely drinks alcohol), 6) frequency of having late-night snacks (≥2 times/d, almost every day, 4–5 d/wk, 2–3 d/wk, rarely), 7) eating breakfast with family or friends (yes/no), 8) often doing one’s own cooking (yes/no), 9) reports weight management behavior (yes/no), 10) having knowledge about a well-balanced diet (yes/no), 11) have financial limitations (yes/no), 12) presence of stores nearby to buy breakfast (yes/no), and 13) frequency of breakfast (d/wk). For the purpose of analysis, some responses were operationalized as binary or categorical variables where appropriate.

Attitude, subjective norm, and perceived behavior control (PBC) of the Theory of Planned Behavior. Attitude, subjective norm, and PBC of the Theory of Planned Behavior were assessed. Questions were made referring to the sample TPB questionnaire by Ajzen (10).

Attitude was assessed as the average of 5 items with 7-point Likert scale (e.g. Eating ≥70 g vegetable intake at breakfast is 1. Extremely bad to 7. Extremely good). All students scored 1 to 7. Internal consistency was assessed by a Cronbach’s alpha (0.838). Subjective norm was assessed as the average of 4 items with 7-point Likert scale (e.g. “Most people who are important to me think that I should not eat ≥70 g vegetable intake at breakfast” to 7. “I should eat ≥70 g vegetable intake at breakfast”) (Cronbach’s alpha=0.883). PBC was assessed as the average of 4 items with 7-point Likert scale (e.g. “Whether or not I eat ≥70 g vegetable intake at breakfast is up to me” 1. Strongly disagree to 7. Strongly agree) (Cronbach’s alpha=0.814).

Statistical analysis. Among the 2,816 students who

Table 1. Characteristics of subjects.

|             | n   | %  |
|-------------|-----|----|
| Faculty     |     |    |
| Applied Bioscience | 174 | 12.0 |
| Nursing     | 5   | 0.3 |
| Engineering | 453 | 31.1 |
| Information Technology | 512 | 35.2 |
| Creative Engineering | 311 | 21.4 |
| Year        |     |    |
| Sophomore  | 546 | 37.5 |
| Junior     | 466 | 32.0 |
| Senior     | 443 | 30.4 |
| Living arrangement |     |    |
| Living with family | 1,065 | 73.2 |
| Living alone | 390 | 26.8 |

Table 2. Comparison of demographic characteristics between the category of vegetable intake at breakfast.

| Vegetable intake (≥70 g) at breakfast | 0–2 d/wk (n=756) | >2 d/wk (n=699) | p-value† |
|--------------------------------------|------------------|-----------------|----------|
| Faculty                              |                  |                 |          |
| Applied Bioscience                   | 86 (11.4%) 88 (12.6%) | 0.779 |
| Nursing                             | 2 (0.3%) 3 (0.4%) |                  |          |
| Engineering                         | 230 (30.4%) 223 (31.9%) |                  |          |
| Information Technology              | 269 (35.6%) 243 (34.8%) |                  |          |
| Creative Engineering                | 169 (22.4%) 142 (20.3%) |                  |          |
| Year                                 |                  |                 |          |
| Sophomore                           | 274 (36.2%) 272 (38.9%) | 0.369 |
| Junior                              | 240 (31.7%) 226 (32.3%) |                  |          |
| Senior                              | 242 (32.0%) 201 (28.8%) |                  |          |
| Living arrangement                  |                  |                 |          |
| Living with family                  | 517 (68.4%) 548 (78.4%) | <0.001 |          |
| Living alone                         | 239 (31.6%) 151 (21.6%) |                  |          |

† Chi-squared test was conducted.
Table 3. Comparison of the items of the Theory of Planned Behavior between the category of vegetable intake at breakfast.

| Category                              | 0–2 d/wk (n=517) | >2 d/wk (n=548) | p-value† |
|---------------------------------------|------------------|-----------------|----------|
|                                       | Median 25% 75%   | Median 25% 75%  |          |
| Attitude                              |                  |                 |          |
| Students living with family            |                  |                 |          |
|                                       | 5.8 (5.0 6.4)    | 6.4 (5.4 7.0)   | <0.001   |
| Subjective norm                       | 4.5 (4.0 5.5)    | 5.5 (4.3 7.0)   | <0.001   |
| Perceived behavior control            | 4.0 (3.5 5.4)    | 5.5 (4.3 7.0)   | <0.001   |
| Students living alone                 |                  |                 |          |
|                                       | 6.2 (5.2 6.6)    | 6.4 (5.8 7.0)   | 0.005    |
|                                       | 5.0 (4.0 6.0)    | 6.3 (5.0 7.0)   | <0.001   |
|                                       | 4.5 (6.0 5.5)    | 5.3 (4.3 6.3)   | <0.001   |

† Mann–Whitney U test was conducted.

Table 4. Comparison of lifestyle, eating habits, environmental factors, knowledge, and attitudes between the category of vegetable intake at breakfast (students living with family).

| Category                              | 0–2 d/wk (n=517) | >2 d/wk (n=548) | p-value† |
|---------------------------------------|------------------|-----------------|----------|
|                                       |                  |                 |          |
| Smoking status                        |                  |                 |          |
| Never/Past smoking                    | 487 (94.2%)      | 492 (89.8%)     | 0.008    |
| Current smoking                       | 30 (5.8%)        | 56 (10.2%)      |          |
| Sleep duration                        |                  |                 |          |
| ≥6 h                                  | 259 (50.1%)      | 265 (48.4%)     | 0.570    |
| <6 h                                  | 258 (49.9%)      | 283 (51.6%)     |          |
| Subjective sleep satisfaction         |                  |                 |          |
| Sufficient sleep                      | 339 (65.6%)      | 388 (70.8%)     | 0.067    |
| Insufficient sleep                    | 178 (34.4%)      | 160 (29.2%)     |          |
| Alcohol intake (days/wk)              |                  |                 |          |
| <1                                    | 418 (80.9%)      | 433 (79.0%)     | 0.455    |
| ≥1                                    | 99 (19.1%)       | 115 (21.0%)     |          |
| Having late-night snacks (days/wk)    |                  |                 |          |
| Rarely                                | 283 (54.7%)      | 332 (60.6%)     | 0.054    |
| ≥2                                    | 234 (45.3%)      | 216 (39.4%)     |          |
| Eating breakfast with family or friends|                |                 |          |
| Yes                                   | 227 (43.9%)      | 309 (56.4%)     | <0.001   |
| No                                    | 290 (56.1%)      | 239 (43.6%)     |          |
| Often doing one’s own cooking         |                  |                 |          |
| Yes                                   | 138 (26.7%)      | 175 (31.9%)     | 0.061    |
| No                                    | 379 (73.3%)      | 373 (68.1%)     |          |
| Reports weight management behavior     |                  |                 |          |
| Yes                                   | 197 (38.1%)      | 270 (49.3%)     | <0.001   |
| No                                    | 320 (61.9%)      | 278 (50.7%)     |          |
| Having knowledge about a well-balanced diet |            |                 |          |
| Yes                                   | 165 (31.9%)      | 225 (41.1%)     | 0.002    |
| No                                    | 352 (68.1%)      | 323 (58.9%)     |          |
| Have financial limitations            |                  |                 |          |
| No                                    | 327 (63.2%)      | 362 (66.1%)     | 0.338    |
| Yes                                   | 190 (36.8%)      | 186 (33.9%)     |          |
| Presence of stores nearby to buy breakfast |            |                 |          |
| Yes                                   | 416 (80.5%)      | 468 (85.4%)     | 0.032    |
| No                                    | 101 (19.5%)      | 80 (14.6%)      |          |

† Chi-squared test was conducted.
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answered the questionnaire, female students ($n=485$), who were considerably fewer than the male students, and those who had missing values ($n=86$) were excluded. Moreover, 790 students who skip breakfast (less than 3 d/wk) (11) were excluded because skipping breakfast affects the frequency of vegetable intake. Finally, the data of 1455 male students were analyzed.

They were divided into 2 groups based on the median (2 d/wk) of the frequency of ≥70 g vegetable intake at breakfast. Then, lifestyle, eating habits, environmental factors, knowledge, and attitudes were compared using a chi-squared test. Comparison of median scores of attitude, subjective norm, and PBC between the two groups were conducted by using a Mann–Whitney $U$ test. Logistic regression analysis was then performed using the variables with significant associations ($p<0.05$) as independent variables and category of vegetable intake at breakfast as a dependent variable. Because attitude, subjective norm, and PBC were highly correlated, only PBC, which had the highest correlation with the frequency of ≥70 g vegetable intake at breakfast was used for logistic regression analysis. The analyses were conducted considering living conditions.

All statistical analyses were carried out using SPSS for Windows, version 24.0 (SPSS Inc., Tokyo, Japan). Statistical significance was defined as a two-tailed $p<0.05$ for all analyses.

RESULTS

Characteristics of the subjects

The characteristics of the subjects are shown in Table 1. The highest proportion of the subjects was Information Technology (35.2%), followed by Engineering (31.1%), Creative Engineering (21.4%) and Applied Bioscience (12.0%). The least number of students were in the Nursing category (0.3%). The proportions of sopho-
Comparison of demographic characteristics between two groups according to the frequency of ≥70 g vegetable intake at breakfast

The results of the comparison between the groups are shown in Table 2. While there were no significant differences between the groups in Faculty and Year, the proportion of students living with family in the high vegetable intake group (>2 d/wk) was significantly higher than the low vegetable intake group (0–2 d/wk). Therefore, subsequent analysis was conducted by living arrangement.

Comparison of the items of the Theory of Planned Behavior between two groups according to the frequency of ≥70 g vegetable intake at breakfast

The median scores of the items of Attitude, Subjective norm, and PBC were compared (Table 3). In both students living with family and those living alone, the median value of each item in the high vegetable intake group was significantly higher than that in the low vegetable intake group.

Associated factors with vegetable intake at breakfast

Lifestyle, eating habits, environmental factors, knowledge, and attitudes between the category of vegetable intake at breakfast were compared (Tables 4 and 5). Significant differences were seen in the following items in the students living with their family: smoking status, eating breakfast with family or friends, reports weight management behavior, having knowledge about a well-balanced diet, and presence of stores nearby to buy breakfast. In the students living alone, significant differences were seen in the items of often doing one’s own cooking and having knowledge about a well-balanced diet.

The results of the logistic regression analysis using the significant variables are shown in Table 6. Eating breakfast with family or friends and PBC were positively associated with ≥70 g vegetable intake in students living with their family. On the other hand, often doing one’s own cooking, having knowledge about a well-balanced diet, and PBC were positively associated with ≥70 g vegetable intake in the students living alone.

### DISCUSSION

In this study, we aimed to examine the factors associated with vegetable intake at breakfast. As far as we know, few studies have examined the predictors of vegetable intake at breakfast among university students.

This study showed a PBC to eat vegetables at breakfast were associated with ≥70 g vegetable intake at breakfast in both students living with family and students living alone. The previous review has indicated self-efficacy is one of the predictors of adult vegetable intake (5). Thus, these results support the previous finding.

Some associated factors differed by living arrangement. Regarding the students living with family, eating breakfast with family or friends were positively associated with vegetable intake. Significant positive associations were shown for family meal frequency and vegetable intake in adults (12). Family meals provide an opportunity for parents to model healthful eating behaviors or make healthful foods available to family members (13). These reasons may promote students’ vegetable intake at breakfast.

Knowledge about a well-balanced diet and doing one’s own cooking were associated with ≥70 g vegetable intake in students living alone, suggesting the need for one’s effort to eat vegetables at breakfast. Previous studies suggested that knowledge about the recommended amount of vegetable intake (6–8) predict vegetable intake. Therefore, dietary education regarding the recommended amount of vegetable intake and a well-balanced diet, such as including staple food, meat or fish and vegetables, may be effective for them. Concerning doing one’s own cooking, a study with 18–23-y young adults reported that those who frequently prepared meals were more likely to meet dietary objectives (Healthy people 2010) for fat, calcium, fruit, vegetable, and whole-grain consumption than those who less frequently prepared meals (14), suggesting the importance

### Table 6. Odds ratios for factors associated with vegetable intake at breakfast.

| OR          | 95% confidence interval | p-value† |
|-------------|-------------------------|----------|
| Students living with family >
| Smoking status | 0.65 | (0.40–1.07) | 0.093 |
| Eating breakfast with family or friends | 1.31 | (1.00–1.70) | 0.046 |
| Reports weight management behavior | 1.26 | (0.97–1.65) | 0.085 |
| Having knowledge about a well-balanced diet | 1.18 | (0.90–1.55) | 0.240 |
| Presence of stores nearby to buy breakfast | 1.21 | (0.86–1.70) | 0.283 |
| Perceived behavior control | 1.61 | (1.47–1.77) | <0.001 |
| Students living alone >
| Often doing one’s own cooking | 1.79 | (1.07–2.98) | 0.026 |
| Having knowledge about a well-balanced diet | 1.65 | (1.08–2.54) | 0.022 |
| Perceived behavior control | 1.42 | (1.21–1.66) | <0.001 |

† Logistic regression analysis was conducted.
of cooking by oneself on healthy eating. Surprisingly, in this study, 74.4% of the students living alone responded that they often did their own cooking. Thus, in addition to the knowledge dissemination, cooking education (e.g. how to cook vegetables for a short time or how to cook a make-ahead dish) or giving advice to always keep vegetables and/or vegetable dishes in the refrigerator may be effective.

This study has some limitations. First, because of the cross-sectional design, we were unable to determine causal relationships. Second, eating 70 g of vegetable intake at breakfast was not actually measured. However, examples of 70 g of vegetable dish were illustrated in the questionnaire. Third, this study was conducted at one university. Therefore, our results may not apply to the students of other universities. Despite these limitations, this study included a relatively large number of participants and examined with wide range of factors. It is noteworthy that few studies have examined the predictors of vegetable intake at breakfast and our results showed the factors associated with vegetable intake differed by living arrangement.

In conclusion, this study suggests that, along with PBC, different factors pertaining to an individual’s living condition may need to be considered to increase vegetable intake at breakfast. Because our subjects were only male university students, future studies focusing on female university students are needed.

Disclosure of state of COI

No conflicts of interest to be declared.

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