Dietary intake, mental status, physical activity, and lifestyle affecting bowel movement frequency and stool texture in young Japanese women

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Constipation is a symptom-based disorder, and its definition is mainly subjective. Patients are more concerned with ease of passage and consistency rather than frequency of bowel movement. Studies on bowel movement frequency and stool texture in the general population are sparse, especially in young women. In this cross-sectional study, data obtained from self-administered questionnaires, including age, height, body weight, lifestyle, food habits, anxiety, depressive status, frequency of bowel movements, stool texture, and defecation-related symptoms were analyzed in 245 female Japanese university students. An established semiquantitative questionnaire available for clinical investigation (FFQg) was used to obtain a detailed assessment of food intake and physical activity levels. Of the participants, 21.4% had bowel movements ≤3 times per week and 33.3% had hard or lumpy stools ≥25% and loose (mushy) or watery stools <25% of bowel movements. There was a positive association between infrequent bowel movements and hard or lumpy stools. These two situations both caused similar symptoms such as a sensation of incomplete evacuation and straining. There was no association of bowel movement frequency and stool texture with any specific nutrients and foods, dietary intake, mental status, or physical activity. Several lifestyle factors such as regular bowel movements and hesitation with evacuation were associated with bowel movement frequency and stool texture. Several lifestyle factors, but not mental, physical, or dietary intake factors, were associated with bowel movement frequency and stool texture in young Japanese women.

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Key words: bowel movement, stool texture, young women, lifestyle, food intake

Introduction

Gastrointestinal (GI) symptoms are a common occurrence in the Japanese general population. In a prospective cohort study, Tokuda et al. reported that the incidence of GI symptoms was 25%, and that abdominal pain, diarrhea, nausea, constipation, and dyspepsia were the most frequent symptoms.[1] These symptoms occurred more often in young women. Participants were more likely to treat themselves, using dietary, complementary, or alternative medicines, than to visit physicians.

Constipation is a common health problem characterized by a sensation of impaired defecation; it can impair quality of life both physically and mentally.[2-4] However, only a small proportion of symptomatic patients suffering from constipation seek medical consultation.[2,5] Causes of constipation vary and may be multifactorial including obstructive, metabolic, neurological, psychiatric, or functional causes.[6] Constipation can be an acute or chronic condition, and most commonly, chronic constipation is primary and idiopathic.[7,8]

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Most patients with chronic constipation have either functional constipation or constipation-predominant irritable bowel syndrome (IBS).[9] Chronic constipation has been reported to be more common in women than in men.[2,3,5,7,10-17]

The reported prevalence of constipation ranges from 2 to 38% in many countries,[3,5-7,12,14,17-20] although it varies depending on the definition of constipation used.[18] Unfortunately, there is no gold standard for defining constipation,[12] and many definitions have been used, ranging from self-reported ratings to consensus criteria such as Rome III criteria.[5,8] Common definitions include infrequent or difficult defecation, such as straining, hard or lumpy stools, and incomplete evacuation.[12,15,21] Functional constipation, one of the most common types of constipation, is defined by the Rome III criteria.[22] Although the Rome III criteria are frequently used to define functional constipation, they are rarely used in clinical practice.[23,24] Interestingly, the prevalence of self-reported constipation was reported to be higher than that defined by Rome I, II, and III criteria.[12] Symptoms of constipation vary from a relatively mild bowel habit disturbance to severe sequelae.[18] Symptoms related to difficult defecation are more frequent and more troublesome than infrequent bowel movements.[2,15]

In addition to age, gender and mental status (depression),[12] modifiable lifestyle factors such as smoking habits, alcoholic consumption, body mass index (BMI), physical activity, and skipping meals have been associated with constipation.[10,13,16-18,25] Moreover, constipation has also been reported to be associated with the consumption of some foods.[18,19,21] However, comprehensive studies on such associations in young Japanese women are sparse. In the present study, we aimed to investigate whether dietary intake, mental status, physical activity, and lifestyle factors are associated with bowel movement frequency and stool texture in female Japanese university students.

Participants and methods

Study participants

In the present study, we used the same database as in our previous study in which the primary aim was to investigate the prevalence of IBS in female Japanese university students:[9] 396 female students from the Faculty of Nursing and Nutrition, University of Nagasaki, Japan were invited to enroll, and 245 students (128 from the Department of Nutrition, 116 from the Department of Nursing, and one student from an unknown department) agreed to participate in June 2012. The study participation rate was 61.9%. Women were

asked to sign an informed consent form before participating in the study.

Study design

The present study was a cross-sectional study conducted from June through July 2012. Participants completed self-administered questionnaires that included 125 questions regarding personal data, such as age, height, body weight, lifestyle, food habits, anxiety, depressive status, frequency of bowel movements and stool texture, and defecation-related symptoms. An established semiquantitative questionnaire available for clinical investigation (a food frequency questionnaire based on food groups, the FFQg ver. 3.5; Kenpaku-sha, Tokyo, Japan) was used to obtain a detailed assessment of food intake and physical activity levels.[26] Body mass index (BMI) was calculated as body weight (kg) divided by height squared (m^2).

Food intake frequency

Data regarding portion size and the frequency of consumption of 29 food groups, including staples (rice, bread, and noodles), within one week were calculated using the established semiquantitative questionnaire FFQg ver. 3.5 (Kenpaku-sha). Using these data, the determined amount of each nutrient and food group according to the 2010 edition of the Standard Tables of Food Composition in Japan[27] and the determined dish category according to the Japanese Food Guide Spinning Top[28] were estimated using a computer software program that is based on the standard tables of food composition in Japan 2010.[27] In the Japanese Food Guide Spinning Top, the quantity of each dish category is expressed as "tsu" or SV. SV is an abbreviation for "serving", which is a simple countable number describing the approximated amount of each dish or food served to one person in Japan.[28] The estimated nutrients were as follows: total energy; water; protein; total lipids; carbohydrates; ash; sodium; potassium; calcium; magnesium; phosphate; iron; zinc; copper; manganese; retinol; α-, and β-carotene; cryptoxanthin; equivalent amount of β-carotene; equivalent amount of retinol; vitamin D; α-, β-, γ-, and δ-tocopherol; equivalent amount of tocopherol; vitamin K; vitamins B1, B2, B6, and B12; niacin; folic acid; pantothenic acid; vitamin C; saturated fatty acids; mono-unsaturated fatty acids; poly-unsaturated fatty acids; cholesterol; water-soluble fibers; water-insoluble fibers; total fibers; salt; total fatty acids; and n-3, and n-6 poly-unsaturated fatty acids.[27] The estimated foods were grouped into the following groups: cereals (rice, noodle,

etc); potatoes and starches; green-yellow vegetables; light-colored and other vegetables; mushrooms; seaweed; beans; fish/shellfish; meats; eggs; milk/dairy products; fruits; snacks; beverages; sugar/sweets; nuts; oils/fats; and seasonings/spices.[27] The estimated dish categories were categorized into the following: grain dishes (rice, bread, noodles, and pasta); vegetable dishes; fish and meat dishes (meat, fish, egg, and soy-bean dishes); milk (milk and milk products); fruits; and snacks, confection, and beverages.[28]

Physical activity level

The physical activity level (PAL), calculated as the total energy expenditure (TEE) divided by the basal metabolic rate (BMR), was estimated using a computer software program (FFQg ver. 3.5; Kenpaku-sha).[29] For individuals between 18 to 69 years of age, a PAL of <1.6 was designated as level I, a PAL of 1.6-1.9 was designated as level II, and a PAL of >1.9 was designated as level III.[30]

Psychological assessment

The Japanese version of the hospital anxiety and depression scale (HADS), a scale proven to be reliable and valid as a screening method for assessing emotional disorders in women,[31] was used to evaluate symptoms of anxiety and depression. The HADS is a self-administered questionnaire that consists of 14 items, seven items for anxiety (HADS-A) and seven items for depression (HADS-D), scored between 0 and 3. A total score of >10 was considered to represent a positive result ("definite"), a score of 8-10 represented a "probable" result, and a score of <8 represented a negative result for either condition.[32]

Frequency of bowel movements

Most people who have bowel movements between three times per day and three times per week and pass good textured feces (not too hard or soft) can be said to have "normal" bowel behavior.[12] In the Rome III criteria, diagnostic criteria of functional constipation include the frequency of bowel movement as "fewer than three bowel movements per week".[23] In contrast, Murakami et al.[18] reported that the mean number of bowel movements per week in young Japanese women who thought themselves to be "constipated" was 3.4 ± 1.1, and constipation was defined as ≤ 3 bowel movements per week in their study. Therefore, participants in this study were classified into two groups: the infrequent group (I group) included women who reported ≤ 3 bowel move-

ments per week in the past year; the frequent group (F group) included women who reported > 3 bowel movements per week in the past year. Bowel movements of "more than 3 times per week" can be interpreted as "at least one per two days".

Stool texture

Participants were classified into three groups using the Bristol Stool Form Scale:[33] the hard stool group (H group) included women who reported hard or lumpy stools for ≥ 25% and loose (mushy) or watery stools for < 25% of bowel movements during the past three months; the soft stool group (S group) included women who reported loose (musky) or watery stools for ≥ 25% and hard or lumpy stools for < 25% of bowel movements during the past three months; and the other group (O group) included women who reported insufficient abnormalities in stool consistency to meet either of the above criteria.

Frequency of bowel movement and stool textures

Participants were further classified into six groups as follows: IH group (participants who were classified into both the I group and H group); FH group (participants who were classified into both the F group and H group); IO group (participants who were classified into both the I group and O group); FO group (participants who were classified into both the F group and O group); IS group (participants who were classified into both the I group and S group); and FS group (participants who were classified into both the F group and S group).

Ethical considerations

This study was performed according to the principles of the Declaration of Helsinki. The study protocol was approved by the Ethical Committee of the University of Nagasaki, and informed consent was obtained from all participants.

Statistical analysis

Data are expressed as the mean ± standard deviation (SD). Differences between groups were tested for statistical significance using Student's t-test, one-way analysis of variance (ANOVA), followed by Tukey's post-hoc test, chi-square test, or Fisher's exact probability test. A multivariate analysis was performed for variables that were found to be significant in the univariate analyses using a logistic regres-

sion analysis. Correlations were examined using a linear regression analysis with coefficients of correlation. All data analyses were performed using the IBM SPSS statistics software program version 22 (IBM Co., Armonk, NY, USA) on a computer with a Windows operating system. A *p*-value of less than 0.05 was considered to be statistically significant.

Results

Overall characteristics of 245 participants

Participants ranged in age from 18 to 32 years, with a mean age of 19.8 ± 1.6 years. Of the 245 university students, 65 were in the first year, 72 were in the second year, 44 were in the third year, and 61 were in the fourth year (the remaining 3 were unknown). The mean ($\pm$ SD) height, body weight and BMI were 1.58 ± 0.05 (m), 51.5 ± 6.6 (kg) and 20.5 ± 2.2 (kg/m^2), respectively. The mean ($\pm$ SD) amount of sleeping time (a period of time spent sleeping) was 384.4 ± 56.2 minutes. Of the participants, 9 (3.7%) skipped meals (mainly breakfast) almost daily. Only one (0.4%) and two (0.8%) had alcohol drinking and cigarette smoking habits, respectively.

The mean ($\pm$ SD) intake of total energy, protein, total lipids, and carbohydrates per day was 1655.1 ± 383.8 (kcal), 56.6 ± 16.0 (g), 59.8 ± 18.4 (g), and 214.5 ± 48.2 (g), respectively. The mean ($\pm$ SD) intake of magnesium, cholesterol, and total fiber was 183.4 ± 57.1 (mg), 303.1 ± 102.2 (mg), and 9.8 ± 3.5 (g), respectively. With respect to physical activity, the mean ($\pm$ SD) PAL was 1.69 ± 0.39. Of the 244 participants with available data for a psychological assessment using the HADS, 54 (22.1%) were classified as exhibiting a "definite" anxiety state and 17 (7.0%) were classified as exhibiting a "definite" depressive state.

Of the 243 participants with available data for the mean frequency of bowel movements during the past year, 52 (21.4%) reported bowel movements ≤ 3 times per week, 85 (35.0%) reported bowel movements 4 to 6 times per week, 106 (43.6%) reported bowel movements 1 to 2 times per day, and no one reported bowel movements ≥ 3 times per day. Therefore, 52 (21.4%) were classified into the I group and 191 (78.6%) were classified into the F group. Of the 237 participants with available data for the stool texture during the past three months, 79 (33.3%), 31 (13.1%) and 127 (53.6%) were classified into the H group, S group and O group, respectively. Of the 235 participants with available data for both the mean frequency of bowel movements during the past year and stool texture during the past three months, 32 (13.6%) were classified into the IH group, 46

(19.6%) were classified into the FH group, 15 (6.4%) were classified into the IO group, 111 (47.2%) were classified into the FO group, 4 (1.7%) were classified into the IS group, and 27 (11.5%) were classified into the FS group. Of the 243 participants with available data, 9 (3.7%) usually felt a sensation of incomplete evacuation after defecation, and 25 (10.3%) usually strained at defecation.

Comparison of characteristics between the I group and F group

Table 1 shows comparisons of main subject characteristics in the I group and F group. The I group had a significantly higher body weight than the F group, but there were no significant differences between groups in age, height, BMI, department (Department of Nutrition or Department of Nursing), and year in the university. Significantly fewer participants in the I group reported trying to eat a nutritionally balanced meal than those in the F group. Participants who ate plenty of snacks between meals and who reported an increased appetite when they felt stressed or tired were significantly more common in the I group than in the F group. There were no significant differences in the consumption of any of the nutrients, food groups, and dish categories between groups. Also, physical activity as evaluated by PAL and psychological status (anxiety and depressive status) as evaluated according to the HADS were similar between groups. The percentage of participants who were classified into the H group was higher in the I group. Also, a significantly greater number of participants who did not have a daily scheduled time for defecation, who hesitated with evacuation of stool, who felt a sensation of incomplete evacuation after defecation, who strained at defecation, and who felt abdominal distension was observed in the I group than in the F group. Borborygmus (rumbling stomach) and diarrhea during menstruation were less common in I group.

Comparison of characteristics among the H group, O group, and S group

Table 2 shows comparisons of main subject characteristics in the H, O, and S groups. Participants' height was significantly higher in the S group than in the O group, but there were no significant differences in age, height, body weight, BMI, department, and year in the university among groups. The percentage of participants who were trying to eat a nutritionally balanced meal, who ate plenty of snacks between meals, and who reported an increased appetite when they felt stressed or tired were similar among groups. Participants in the S group (7/22, 24.1%) were significantly more likely to

being taking dietary supplements for vitamins or minerals compared with H group (6/77, 7.8%) or O group (8/125, 6.4%). There were no significant differences in the consumption of any of the nutrients, food groups, or dish categories among groups. Also, PAL and HADS scores were similar among groups. The percentage of participants who were classified into the I group was highest for the H group. Similarly, the percentage of participants who did not have a daily scheduled time for defecation, who hesitated with evacuation of stool, who felt a sensation of incomplete evacuation after defecation, who strained at defecation, and who felt abdominal distension was highest in H group. Conversely, participants who hesitated with evacuation of stool and who usually felt a sensation of incomplete evacuation after defecation were rare in the O group. Borborygmus (rumbling stomach) was less common in the H group. Participants who were trying to cope with abnormal bowel movements, such as constipation or diarrhea, were most common in the S group.

Comparison of characteristics among the IH group, FH group, IO group, FO group, IS group, and FS group

Table 3 shows comparisons of main subject characteristics in the six subgroups. There were no significant differences in age, height, body weight, BMI, department, and year in the university among the six groups. Body weight, BMI and sleeping time were highest in the IS group, although differences were not significant and the number of participants in the IS group was small (n=4). The percentage of participants who were trying to eat a nutritionally balanced meal, who ate plenty of snacks between meals, and who reported an increased appetite when they felt stressed or tired was similar among groups. Participants who knew their own ideal body weight were most common in the IH group. There were no significant differences in the consumption of any of the nutrients, food groups, and dish categories among groups. It was noted that intakes of total energy, carbohydrates, magnesium, cholesterol, and total fibers in nutrients; cereals, beans, meats, eggs, milk/dairy products, and fruits in the food group; and grain dishes in the dish category were lowest in the IS group, although differences were not significant and the number of participants in the IS group was small (n=4). PAL and HADS scores were similar among groups. Participants who usually evacuated during the same daily period of time were common in the FO group and FS group. The percentage of participants who hesitated with evacuation of stool was highest in the IH group. The percentage of participants who felt a sensation of incomplete evacuation after defecation, who strained at defecation, and who felt abdominal distension was higher in the IH group and IS group. Borborygmus (rumbling stomach) was less common in the IH group and IS group.

Independent predictors of bowel movement frequency and stool texture determined according to a logistic regression analysis

The variables found to be significantly different in comparisons between the I group and F group or among H group, O group and S group were selected for a logistic regression analysis. Consequently, no variable was found to be an independent predictor of bowel movement frequency (between the I group and F group) or stool texture [H group and the other two groups (O group and S group)], respectively.

Discussion

Studies on the bowel movement frequency and stool texture in the general population are sparse, especially in young women.[16,25,34] In the present study, 21.4% of young Japanese women had infrequent bowel movement (≤ 3 times per week). This prevalence rate was larger than that in previously reported studies in women using the same criteria (6.5% in India and 11.5% in England).[16,35] Panigrahi et al. reported that female gender was one of the independent predictors of ≤ 3 bowel movements per week.[16] These women (I group) seemed to be less concerned for their health problem than women in the F group, because they were unlikely to eat nutritionally balanced meals and more likely to eat more snacks between meals in the present study. Moreover, these women tended to experience increased appetites when they felt stressed or tired. These findings may explain the higher body weight and BMI in the I group compared with the F group. Sanjoaquin et al. reported that there was a positive association between BMI and the mean number of weekly bowel movements for both men and women.[13] The reason for the discrepancy between the results from Sanjoaquin et al. and ours may be due to differences in subjects' age and BMI, because the median age and mean BMI of 15,976 women in their study was 48.3 years and 25.6 kg/m^2, respectively.[13] With respect to stool texture, Heaton et al. reported that lumpy stools were more prevalent in women than men of the same age.[35] In the present study, the percentage of participants who claimed hard or lumpy stools (H group) among young Japanese women (33.3%) was similar to that reported in previous studies conducted in England (26.8%).[35]

Table 1. Comparison of main characteristics between the I group and F group

Characteristics	I group [†] (n=52)	F group [†] (n=191)	p
Age (years)	20.1 ± 1.2	19.7 ± 1.7	0.114
Height (cm)	159.4 ± 5.3	157.9 ± 5.5	0.094
Body weight (kg)	53.5 ± 6.7	50.7 ± 6.5	0.011
BMI (kg/m^2)	21.0 ± 2.2	20.0 ± 3.4	0.059
Sleeping time (min)	386.5 ± 49.2	384.0 ± 57.8	0.774
Skipping meals per week			
6-7 times/2-5 times/Rarely	2/12/38	7/44/140	0.998
Trying to eat a nutritionally balanced meal			
Usually/Occasionally/Rarely	0/30/22	12/123/54	0.042
Quantity of snack between meals			
Plenty/Moderate/Small/Unknown	24/16/2/10	65/96/12/18	0.029
My own ideal body weight			
Know/Not know	46/6	162/29	0.657
Appetite change when feel stressed or tired			
Decrease/Unchanged/Increase	7/10/35	39/63/88	0.027
Dietary supplements for vitamins or minerals			
Taking/Not taking	3/48	19/167	0.426
Alcohol drinking			
Habitual/Occasionally/Never	0/1/51	1/8/182	0.647
Cigarette smoking			
Current/Past/Never	0/0/51	2/0/189	1.000
Nutrients-Total energy (kcal) [‡]	1628.9 ± 414.6	1672.8 ± 367.0	0.464
Nutrients-Carbohydrates (g) [‡]	213.5 ± 46.4	217.1 ± 46.1	0.625
Nutrients-Magnesium (mg) [‡]	177.7 ± 57.6	185.0 ± 57.0	0.417
Nutrients-Cholesterol (mg) [‡]	301.4 ± 122.3	303.6 ± 96.0	0.908
Nutrients-Total fibers (g) [‡]	9.6 ± 3.2	9.9 ± 3.5	0.601
Food group-Cereals (g) [‡]	345.4 ± 79.9	345.6 ± 94.5	0.988
Food group-Beans (g) [‡]	41.1 ± 31.6	43.3 ± 39.8	0.709
Food group-Fish/shellfish (g) [‡]	37.4 ± 29.7	36.8 ± 28.2	0.895
Food group-Meats (g) [‡]	83.9 ± 52.5	86.5 ± 42.9	0.711
Food group-Eggs (g) [‡]	34.0 ± 19.5	33.5 ± 17.6	0.852
Food group-Milk/dairy products (g) [‡]	125.9 ± 98.3	150.6 ± 141.8	0.245
Food group-Fruits (g) [‡]	30.6 ± 31.4	37.5 ± 48.4	0.335
Food group-Snacks (g) [‡]	64.6 ± 41.4	62.0 ± 39.1	0.675
Food group-Nuts (g) [‡]	0.9 ± 1.3	0.8 ± 2.1	0.750
Dish category-Grain dises (SV) [§]	3.2 ± 0.8	3.2 ± 0.9	0.975
Dish category-Vegetable dishes (SV) [§]	2.9 ± 1.4	3.0 ± 1.6	0.956
PAL	1.6 ± 0.3	1.7 ± 0.4	0.170
PAL level			
I/II/III	29/17/5	96/51/38	0.204
Anxiety state			
Definite/Probable/Negative	12/12/28	42/45/104	1.000
Depressive state			
Definite/Probable/Negative	4/18/30	13/46/132	0.277
Stool texture			
H group/O group/S group [†]	32/15/4	46/111/27	<0.001
Daily scheduled time for defecation			
Almost fixed/Not fixed	0/52	57/134	<0.001
Hesitation with evacuation			
Usually/Occasionally/Rarely	2/24/26	8/51/132	0.024
Sensation of incomplete evacuation after defecation			
Usually/Occasionally/Rarely	5/35/12	4/108/79	0.005
Straining at defecation			
Usually/Occasionally/Rarely	11/38/3	14/134/43	0.001
Abdominal distension			
Present/Absent	33/19	72/113	0.002
Borborygmus (rumbling stomach)			
Present/Absent	17/35	108/77	0.002
Diarrhea during menstruation			
Sometimes/Never	16/17	88/38	0.025
Coping with abnormal bowel movements			
Trying/Not trying	27/25	84/107	0.348

Data were expressed as mean ± SD, or the number of participants.
[†] I group (infrequent group) included women who reported ≤ 3 bowel movements per week in the past year, and F group (frequent group) included women who reported > 3 bowel movements per week in the past year.
[‡] According to the 2010 edition of Standard Tables of Food Composition in Japan[27]
[§] According to the Japanese Food Guide Spinning Top. SV (serving) is a simply countable number describing the approximated amount of each dish or food served to one person in Japan.[28]
SD, standard deviation; BMI, body mass index; PAL, physical activity level

Table 2. Comparison of main characteristics among the H group, O group, and S group

Characteristics	H group [†] (n=79)	O group [†] (n=127)	S group [†] (n=31)	p
Age (years)	19.9 ± 1.3	19.7 ± 1.8	19.9 ± 1.3	0.114
Height (cm)	158.9 ± 5.1[ab]	157.6 ± 5.6[a]	160.1 ± 4.9[b]	0.039
Body weight (kg)	51.0 ± 5.5	51.2 ± 7.2	53.3 ± 6.8	0.289
BMI (kg/m^2)	20.2 ± 1.7	20.2 ± 3.6	20.0 ± 4.6	0.951
Sleeping time (min)	382.3 ± 50.6	384.8 ± 57.2	393.2 ± 64.5	0.666
Skipping meals per week				
6-7 times/2-5 times/Rarely	2/20/57	6/24/97	1/9/21	0.635
Trying to eat a nutritionally balanced meal				
Usually/Occasionally/Rarely	6/44/28	5/82/39	0/23/8	0.328
Quantity of snack between meals				
Plenty/Moderate/Small/Unknown	33/33/5/8	43/61/6/17	11/15/3/2	0.730
My own ideal body weight				
Know/Not know	70/9	107/20	26/5	0.635
Appetite change when feel stressed or tired				
Decrease/Unchanged/Increase	15/19/44	23/46/58	7/7/17	0.352
Dietary supplements for vitamins or minerals				
Taking/Not taking	6/71	8/117	7/22	0.012
Alcohol drinking				
Habitual/Occasionally/Never	0/3/76	1/4/122	0/2/29	0.809
Cigarette smoking				
Current/Past/Never	0/0/78	2/0/125	0/0/31	0.643
Nutrients-Total energy (kcal) [‡]	1675.6 ± 360.6	1684.4 ± 362.9	1553.9 ± 383.5	0.244
Nutrients-Carbohydrates (g) [‡]	218.3 ± 41.0	219.6 ± 43.2	201.2 ± 45.9	0.119
Nutrients-Magnesium (mg) [‡]	184.4 ± 57.8	184.5 ± 54.4	173.0 ± 59.9	0.601
Nutrients-Cholesterol (mg) [‡]	314.3 ± 107.2	302.1 ± 101.1	277.2 ± 93.7	0.262
Nutrients-Total fibers (g) [‡]	10.1 ± 3.6	9.8 ± 3.2	9.2 ± 2.6	0.514
Food group-Cereals (g) [‡]	348.9 ± 84.9	353.7 ± 79.0	316.3 ± 106.7	0.109
Food group-Beans (g) [‡]	45.0 ± 40.5	40.0 ± 31.7	51.8 ± 54.4	0.297
Food group-Fish/shelfish (g) [‡]	37.3 ± 25.0	35.8 ± 28.9	40.1 ± 30.9	0.762
Food group-Meats (g) [‡]	83.4 ± 48.3	87.8 ± 43.0	79.6 ± 41.8	0.618
Food group-Eggs (g) [‡]	36.4 ± 19.7	33.1 ± 17.4	28.8 ± 14.9	0.146
Food group-Milk/dairy products (g) [‡]	141.4 ± 117.1	157.0 ± 147.7	117.2 ± 106.7	0.334
Food group-Fruits (g) [‡]	36.4 ± 57.1	35.1 ± 38.3	34.8 ± 38.6	0.976
Food group-Snacks (g) [‡]	66.0 ± 36.9	60.2 ± 42.6	65.1 ± 33.2	0.580
Food group-Nuts (g) [‡]	0.9 ± 1.3	0.8 ± 2.5	0.5 ± 1.1	0.708
Dish category-Grain dishes (SV) [§]	3.3 ± 0.8	3.3 ± 0.7	3.0 ± 1.0	0.130
Dish category-Vegetable dishes (SV) [§]	3.0 ± 1.6	3.0 ± 1.4	2.6 ± 1.2	0.378
PAL	1.7 ± 0.7	1.6 ± 0.8	1.7 ± 0.8	0.160
PAL level				
I/II/III	37/27/11	70/32/24	16/7/7	0.481
Anxiety state				
Definite/Probable/Negative	17/22/40	31/26/70	5/8/18	0.689
Depressive state				
Definite/Probable/Negative	6/26/47	11/28/88	0/10/21	0.196
Frequency of bowel movements				
I group/F group [†]	32/46	15/111	4/27	<0.001
Daily scheduled time for defecation				
Almost fixed/Not fixed	6/73	41/86	9/22	<0.001
Hesitation with evacuation				
Usually/Occasionally/Rarely	4/32/43	6/27/94	0/13/18	0.013
Sensation of incomplete evacuation after defecation				
Usually/Occasionally/Rarely	5/53/21	3/66/58	1/20/10	0.046
Straining at defecation				
Usually/Occasionally/Rarely	16/56/7	8/91/28	1/20/10	0.001
Abdominal distension				
Present/Absent	44/35	48/77	11/19	0.037
Borborygmus (rumbling stomach)				
Present/Absent	32/47	73/52	18/12	0.032
Diarrhea during menstruation				
Sometimes/Never	31/23	53/26	17/4	0.156
Coping with abnormal bowel movements				
Trying/Not trying	37/42	52/75	21/10	0.027

Data were expressed as mean ± SD, or the number of participants.
Different superscript letters within the same characteristics indicated significant differences at p<0.05.
[†] H group (hard stool group) included women who reported hard or lumpy stools for ≥ 25% and loose (mushy) or watery stools for < 25% of bowel movements during the past three months, S group (soft stool group) included women who reported loose (musky) or watery stools for ≥ 25% and hard or lumpy stools for < 25% of bowel movements during the past three months, and O group (other group) included women who reported insufficient abnormalities in stool consistency to meet either of the above criteria.
[‡] According to the 2010 edition of Standard Tables of Food Composition in Japan[27]
[§] According to the Japanese Food Guide Spinning Top. SV (serving) is a simply countable number describing the approximated amount of each dish or food served to one person in Japan.[28]
SD, standard deviation; BMI, body mass index; PAL, physical activity level

Table 3. Comparison of main characteristics among the IH group, FH group, IO group, FO group, IS group, and FS group

Characteristics	IH group [†] (n=32)	FH group [†] (n=46)	IO group [†] (n=15)	FO group [†] (n=111)	IS group [†] (n=4)	FS group [†] (n=27)	p
Age (years)	20.4 ± 1.2	19.5 ± 1.3	19.6 ± 1.1	19.8 ± 1.9	20.5 ± 0.6	19.8 ± 1.6	0.292
Height (cm)	159.7 ± 5.3	158.4 ± 5.0	159.2 ± 5.9	157.4 ± 5.6	158.5 ± 2.1	160.4 ± 5.2	0.092
Body weight (kg)	52.9 ± 6.4	49.7 ± 4.5	53.9 ± 8.1	50.8 ± 7.0	55.8 ± 3.1	52.8 ± 7.2	0.078
BMI (kg/m^2)	20.7 ± 1.9	19.8 ± 1.6	21.1 ± 3.0	20.1 ± 3.7	22.2 ± 1.2	19.6 ± 4.8	0.476
Sleeping time (min)	390.2 ± 49.6	376.1 ± 51.2	375.7 ± 49.8	386.3 ± 58.4	405.0 ± 52.0	391.4 ± 66.9	0.742
Skipping meals per week							
6-7 times/2-5 times/Rarely	1/8/23	1/11/34	0/3/12	6/21/84	1/1/2	0/8/19	0.503
Trying to eat a nutritionally balanced meal							
Usually/Occasionally/Rarely	0/16/16	6/27/12	0/12/3	5/70/35	0/2/2	0/21/6	0.086
Quantity of snack between meals							
Plenty/Moderate/Small/Unknown	18/6/2/6	14/27/3/2	5/8/0/2	38/53/6/14	1/2/0/1	10/13/3/1	0.190
My own ideal body weight							
Know/Not know	32/0	37/9	12/3	95/16	2/2	24/3	0.019
Appetite change when feel stressed or tired							
Decrease/Unchanged/Increase	3/7/22	12/12/21	3/3/9	20/43/48	1/0/3	6/7/14	0.239
Dietary supplements for vitamins or minerals							
Taking/Not taking	2/29	4/41	0/15	8/101	1/3	6/19	0.089
Alcohol drinking							
Habitual/Occasionally/Never	0/1/31	0/2/44	0/0/15	1/4/106	0/0/4	0/2/25	0.984
Cigarette smoking							
Current/Past/Never	0/0/31	0/0/46	0/0/15	2/0/109	0/0/4	0/0/27	1.000
Nutrients-Total energy (kcal) [‡]	1640.1 ± 386.5	1698.4 ± 346.8	1717.3 ± 465.9	1680.4 ± 350.3	1210.6 ± 290.0	1611.1 ± 371.1	0.177
Nutrients-Carbohydrates (g) [‡]	217.1 ± 43.8	218.8 ± 39.9	220.9 ± 47.8	219.4 ± 43.0	155.6 ± 33.4	208.9 ± 43.6	0.091
Nutrients-Magnesium (mg) [‡]	178.9 ± 54.3	187.9 ± 61.1	188.9 ± 61.6	184.2 ± 53.9	131.3 ± 66.0	179.9 ± 57.4	0.534
Nutrients-Cholesterol (mg) [‡]	306.3 ± 117.0	320.3 ± 101.7	320.7 ± 125.2	298.4 ± 97.4	162.3 ± 83.3	296.4 ± 82.0	0.089
Nutrients-Total fibers (g) [‡]	10.0 ± 3.2	10.1 ± 4.0	9.4 ± 3.5	9.8 ± 3.2	8.3 ± 3.7	9.4 ± 2.5	0.873
Food group-Cereals (g) [‡]	359.0 ± 63.9	340.2 ± 98.0	345.7 ± 81.1	354.7 ± 79.4	233.0 ± 125.9	330.1 ± 99.5	0.080
Food group-Beans (g) [‡]	41.3 ± 36.9	47.4 ± 44.8	46.3 ± 26.7	39.4 ± 32.4	25.0 ± 23.5	56.3 ± 57.0	0.362
Food group-Fish/shelfish (g) [‡]	35.4 ± 28.1	38.2 ± 22.8	43.6 ± 33.5	35.1 ± 28.2	39.3 ± 28.9	40.2 ± 31.8	0.869
Food group-Meats (g) [‡]	80.1 ± 50.3	85.9 ± 47.9	100.2 ± 58.9	86.3 ± 40.5	58.6 ± 43.4	83.1 ± 41.5	0.609
Food group-Eggs (g) [‡]	36.4 ± 19.9	36.6 ± 20.0	33.3 ± 14.5	32.7 ± 17.5	8.9 ± 6.8	32.1 ± 13.2	0.074
Food group-Milk/dairy products (g) [‡]	129.4 ± 102.4	149.7 ± 128.7	126.4 ± 100.4	160.9 ± 153.6	80.6 ± 68.7	123.3 ± 111.7	0.587
Food group-Fruits (g) [‡]	32.0 ± 35.9	39.0 ± 69.4	31.4 ± 24.5	35.7 ± 40.0	18.8 ± 22.1	37.6 ± 40.5	0.950
Food group-Snacks (g) [‡]	62.9 ± 37.8	68.1 ± 37.0	69.8 ± 52.9	59.0 ± 41.3	61.8 ± 30.3	65.6 ± 34.2	0.808
Food group-Nuts (g) [‡]	0.9 ± 1.1	0.9 ± 1.4	0.8 ± 1.4	0.8 ± 2.6	1.1 ± 2.3	0.4 ± 0.8	0.951

							p value
Dish category-Grain dishes (SV) §	3.3 ± 0.6	3.2 ± 0.9	3.3 ± 0.8	3.3 ± 0.7	2.1 ± 1.4	3.1 ± 0.9	0.054
Dish category-Vegetable dishes (SV) §	3.1 ± 1.5	2.9 ± 1.7	2.8 ± 1.4	3.0 ± 1.4	2.8 ± 1.9	2.5 ± 1.2	0.786
PAL	1.5 ± 0.7	1.8 ± 0.8	1.5 ± 0.6	1.7 ± 0.8	1.8 ± 1.0	1.7 ± 0.8	0.793
PAL level							
I/II/III	18/10/3	18/17/8	8/6/1	61/26/23	2/1/1	14/6/6	0.546
Anxiety state							
Definite/Probable/Negative	7/6/19	10/15/21	5/3/7	26/22/63	0/2/2	5/6/16	0.761
Depressive state							
Definite/Probable/Negative	1/15/16	5/11/30	3/1/11	8/27/76	0/2/2	0/8/19	0.068
Daily scheduled time for defecation							
Almost fixed/Not fixed	0/32	6/40	0/15	41/70	0/4	9/18	<0.001
Hesitation with evacuation							
Usually/Occasionally/Rarely	2/17/13	2/14/30	0/2/13	6/24/81	0/4/0	0/9/18	0.003
Sensation of incomplete evacuation after defecation							
Usually/Occasionally/Rarely	4/23/5	1/29/16	0/8/7	3/57/51	1/3/0	0/17/10	0.013
Straining at defecation							
Usually/Occasionally/Rarely	10/20/2	5/36/5	0/14/1	8/76/27	1/3/0	0/17/10	<0.001
Abdominal distension							
Present/Absent	22/10	21/25	7/8	40/69	3/1	8/18	0.014
Borborygmus (rumbling stomach)							
Present/Absent	10/22	22/24	6/9	67/42	1/3	17/9	0.016
Diarrhea during menstruation							
Sometimes/Never	9/12	21/11	3/4	49/22	3/1	14/3	0.106
Coping with abnormal bowel movements							
Trying/Not trying	17/15	19/27	7/8	45/66	3/1	18/9	0.133

Data were expressed as mean ± SD, or the number of participants.

† IH group included women who were classified into both the I group and H group, FH group included women who were classified into both the F group and H group, IO group included women who were classified into both the I group and O group, FO group included women who were classified into both the F group and O group, IS group included women who were classified into both the I group and S group, and FS group included women who were classified into both the F group and S group, according to the definition described in Participants and methods section.

‡ According to the 2010 edition of Standard Tables of Food Composition in Japan[27]

§ According to the Japanese Food Guide Spinning Top. SV (serving) is a simply countable number describing the approximated amount of each dish or food served to one person in Japan.[28]

SD, standard deviation; BMI, body mass index; PAL, physical activity level

Constipation is a symptom-based disorder, and its definition is mainly subjective. Patients are more concerned with ease of passage and consistency rather than frequency of bowel movement.[2] In the present study, there was a strong association between bowel movement frequency and stool consistency: 32 of 52 (61.5%) I group participants were classified into the H group, and conversely, 32 of 79 (40.5%) H group participants were classified into the I group. Moreover, constipation-related symptoms such as a sensation of incomplete evacuation after defecation, straining, and abdominal distension were common in both groups. Participants of both groups are likely to hesitate with evacuation and have irregular bowel movements. These symptoms were more prominent in the IH group: 84.4% of participants usually or occasionally felt a sensation of incomplete evacuation after defecation, 93.8% of participants usually or occasionally strained at defecation, 68.8% of participants complained of abdominal distension, 59.4% of participants usually or occasionally hesitated with evacuation, and none of the participants had a daily scheduled time for defecation.

Among the participants evaluated in the present study, the mean intakes of total energy, carbohydrates, calcium, magnesium, iron, and total fiber per day were lower than the estimated energy requirement, estimated average requirement, recommended dietary allowance, tentative dietary goals for preventing lifestyle-related diseases, or median value stated in the 2010 version of the Dietary Reference Intakes for Japanese.[30] In contrast, the mean intakes of protein, cholesterol, and salt were higher than the recommendations.[30] Constipation has been reported to be associated with some dietary intakes including total energy, dietary fibers, magnesium, rice, beans, fish, meats, eggs, dairy products, fruits, vegetables, fluids or non-alcoholic beverages, coffee, tea, confectioneries, and Japanese traditional dietary pattern (dietary pattern characterized by high intakes of rice, miso soup, and soy products, and low intakes of bread and confectionaries).[13,16,18,19,21] Eda also reported that there was a positive association between bowel movement frequency and daily intakes of total energy, carbohydrate, protein, and lipids in 122 young Japanese women.[25] However, there was no association of bowel movement frequency and stool consistency with any of above estimated dietary factors in the present study. This may be due, at least in part, to the participants' characteristics. Participants were dietetic and nursing students and therefore may be highly health conscious. Because this analysis is based on the cross-sectional study design, it cannot be ruled out that our results merely reflect changes in dietary behaviors after suffering from constipation. In addition, there was no association of bowel movement frequency and stool consistency with alcohol drinking and cigarette smoking habit. This may be because few participants had alcohol drinking and cigarette smoking habit in the present study.[18] Furthermore, this study did not estimate symptomatic constipation but bowel movement frequency and stool texture in young Japanese women, and most participants may not be overly concerned about their bowel habits. This may help explain why physical activity and psychological status (anxiety and depressive status), which can be associate with symptomatic constipation, were similar among groups.

It was noted that S group participants seemed to be more concerned about their health problems, because the proportions of those who were trying to cope with abnormal bowel movements and those who were taking dietary supplements for vitamins or minerals were higher than those in the H group or O group in the present study. It was also noted that body weight, BMI, and sleeping time were highest, and conversely, intakes of total energy, carbohydrates, magnesium, cholesterol, and total fibers in nutrients, cereals, beans, meats, eggs, milk/dairy products, and fruits in the food group, and grain dishes in the dish category were lowest in the IS group among the six groups, although differences were not significant and the number of participants in the IS group was small (n=4). Frequent loose (mushy) or watery stools are another troublesome health problem.

There are several limitations to the present study. First, the prevalence of constipation could not be estimated because neither the Rome III criteria for functional constipation[23] nor a self-reported subjective perception of constipation was used. Second, the current study was a cross-sectional study, which can reveal only associations and not causality between the studied elements. Third, participants in the present study were restricted to female university students in a rural area of the southwestern part of Japan and may not be representative of the general population of young Japanese women. Fourth, the sample size in the present study was relatively small. Fifth, alcohol drinking and cigarette smoking habits may be underestimated because most of our participants who were under 20 years of age can under-report these habits.

In conclusion, our study disclosed that approximately one fifth of young Japanese women had bowel movements ≤ 3 times per week and approximately one third of participants had hard or lumpy stools ≥ 25% of the time and loose (mushy) or watery stools < 25% of the time. There was a positive association between infrequent bowel movements and hard or lumpy stools. These two situations each caused similar symptoms such as a sensation of incomplete evacua-

tion after defecation and straining at defecation. There was no association between bowel movement frequency and stool consistency with any specific nutrients and foods, mental status, or physical activity. Some lifestyle factors were likely to be associated with bowel movement frequency and stool consistency, although causality could not be determined. Further observational and prospective studies are needed to clarify these associations and may lead to effective strategies to prevent this common disorder.

Conflict of interest

All authors have no conflict of interest regarding this paper.

References

1) Tokuda Y, Takahashi O, Ohde S, et al. Gastrointestinal symptoms in a Japanese population:A health diary study. *World J Gastroenterol* 13: 572-578, 2007

2) Pinto Sanchez MI, Bercik P. Epidemiology and burden of chronic constipation. *Can J Gastroenterol* 25 (Suppl B): 11B-15B, 2011

3) Cottone C, Tosetti C, Disclafani G, Ubaldi E, Cogliandro R, Stanghellini V. Clinical features of constipation in general practice in Italy. *United Eur Gastroenterol J* 2: 232-238,2014

4) Nomura H, Agatsuma T, Mimura T. Validity and reliability of the Japanese version of the patient assessment of constipation quality of life questionnaire. *J Gastroenterol* 49: 667-673, 2014

5) Chu H, Zhong L, Li H, Zhang X, Zhang J, Hou X. Epidemiology characteristics of constipation for general population, pediatric population, and elderly population in China. *Gastroenterol Res Pract* 532734, 2014

6) Andrews CN, Storr M. The pathophysiology of chronic constipation. *Can J Gastroenterol* 25 (Suppl B): 16B-21B, 2011

7) McCrea GL, Miaskowski C, Stotts NA, Macera L, Varma MG. A review of the literature on gender and age differences in the prevalence and characteristics of constipation in North America. *J Pain Symptom Manage* 37: 737-745, 2009

8) Gray JR. What is chronic constipation? Definition and diagnosis. *Can J Gastroenterol* 25 (Suppl B): 7B-10B, 2011

9) Omagari K, Murayama T, Tanaka Y, et al. Mental, physical, dietary, and nutritional effects on irritable bowel syndrome in young Japanese women. *Intern Med* 52: 1295-1301, 2013

10) Everhart JE, Go VL, Johannes RS, Fitzsimmons SC, Roth HP, White LR. A longitudinal survey of self-reported bowel habits in the United States. *Dig Dis Sci* 34: 1153-1162, 1989

11) Pare P, Ferrazzi S, Thompson WG, Irvine EJ, Rance L. An epidemiological survey of constipation in Canada: definitions, rates, demographics, and predictors of health care seeking. *Am J Gastroenterol* 96: 3130-3137, 2001

12) Higgins PDR, Johanson JF. Epidemiology of constipation in North America: A systematic review. *Am J Gastroenterol* 99: 750-759, 2004

13) Sanjoaquin MA, Appleby PN, Spencer EA, Key TJ. Nutrition and lifestyle in relation to bowel movement frequency: a cross-sectional study of 20630 men and women in EPIC-Oxford. *Public Health Nutrition* 7: 77-83, 2004

14) Papatheodoridis GV, Vlachogiannakos J, Karaitianos I, Karamanolis DG. A Greek survey of community prevalence and characteristics of constipation. *Eur J Gastroenterol Hepatol* 22: 354-360, 2010

15) Pare P. The approach to diagnosis and treatment of chronic constipation: Suggestions for a general practitioner. *Can J Gastroenterol* 25 (Suppl B): 36B-40B, 2011

16) Panigrahi MK, Kar SK, Singh SP, Ghoshal UC. Defecation frequency and stool form in a coastal eastern Indian population. *J Neurogastroenterol Motil* 19: 374-380, 2013

17) Rajput M, Saini SK. Prevalence of constipation among the general population: a community-based survey from India. *Gastroenterol Nurs* 37: 425-429, 2014

18) Murakami K, Okubo H, Sasaki S. Dietary intake in relation to self-reported constipation among Japanese women aged 18-20 years. *Eur J Clin Nutr* 60: 650-657, 2006

19) Okubo H, Sasaki S, Murakami K, et al. Dietary patterns associated with functional constipation among Japanese women aged 18 to 20 years: A cross-sectional study. *J Nutr Sci Vitaminol* 53: 232-238, 2007

20) Ferrazzi S, Thompson GW, Irvine EJ, Pare P, Rance L. Diagnosis of constipation in family practice. *Can J Gastroenterol* 16: 159-164, 2002

21) Murakami K, Sasaki S, Okubo H, et al. Food intake and functional constipation: A cross-sectional study of 3,835 Japanese women aged 18-20 years. *J Nutr Sci Vitaminol* 53: 30-36, 2007

22) Drossman DA. The functional gastrointestinal disorders and the Rome III process. *Gastroenterology* 130: 1377-1390, 2006

23) Longstreth GF, Thompson WG, Chey WD, Houghton LA, Mearin F, Spiller RC. Functional bowel disorders. *Gastroenterology* 130: 1480-1491, 2006

24) Storr M. Chronic constipation: Current management and challenges. *Can J Gastroenterol* 25 (Suppl B): 5B-6B, 2011

25) Eda S. Relationship between bowel habit and food intake of the female college students. *Bulletin of Yonezawa Women's Junior College* 36: 113-119, 2001 (in Japanese with English abstract)

26) Takahashi K, Yoshimura Y, Kaimoto T, Kunii D, Komatsu T, Yamamoto S. Validation of a food frequency questionnaire based on food groups for estimating individual nutrient intake. *Jpn J Nutr* 59: 221-232, 2001 (in Japanese with English abstract)

27) Council for Science and Technology, Ministry of Education, Culture, Sports, Science and Technology, Japan. 2010. Standard tables of food composition in Japan 2010. Kagawa Education Institute of Nutrition, Tokyo (in Japanese)

28) Yoshiike N, Hayashi F, Takemi Y, Mizoguchi K, Seino F. A new food guide in Japan. The Japanese Food Guide Spinning Top. *Nutr Rev* 65: 149-154, 2007

29) Ishikawa-Takata K, Tabata I, Sasaki S, et al. Physical activity level in healthy free-living Japanese estimated by doubly labelled water method and international physical activity questionnaire. *Eur J Clin Nutr* 62: 885-891, 2008

30) Department of Nutritional Epidemiology, National Institute of Health and Nutrition, Japan 2011-2012. Dietary reference intakes for Japanese -2010-. The summary report from the scientific committee of "dietary reference intakes for Japanese". [cited 2015/7/23]; Available from: http://www0.nih.go.jp/eiken/info/pdf/dris2010en.pdf.

31) Hatta H, Higashi A, Yashiro H, et al. A validation of the hospital anxiety and depression scale. *Jpn J Psychosom Med* 38: 309-315, 1998 (in Japanese with English abstract).

32) Zigmond AS, Snaith RP. The hospital anxiety and depression scale. *Acta Psychiatr Scand* 67: 361-370, 1983

33) O'Donnell LJD, Virjee J, Heaton KW. Detection of pseudodiarrhoea by simple clinical assessment of intestinal transit rate. *Br Med J* 300: 439-440, 1990

34) Bassotti G, Bellini M, Pucciani F, et al. An extended assessment of bowel habits in a general population. *World J Gastroenterol* 10: 713-716, 2004

35) Heaton KW, Radvan J, Cripps H, Mountford RA, Braddon FEM, Hughes AO. Defecation frequency and timing, and stool form in the general population: a prospective study. *Gut* 33: 818-824, 1992