Background Factors Involved in the Epidemiology of Functional Constipation in the Japanese Population

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Abstract

Background: Little is known about the prevalence and epidemiology of functional constipation (FC), a functional bowel disorder with symptoms of constipation. This study aimed to examine the prevalence, population composition, lifestyle, quality of life, and clinical characteristics of individuals with and without FC and of individuals with a strong or weak awareness of constipation.

Methods: An internet survey revealed that 262 (8.7%) out of 3,000 respondents from the general Japanese population were diagnosed with FC. Moreover, all respondents were classified according to their awareness of constipation (i.e. strong or weak), and their characteristic features were compared.

Results: FC occurrence was associated with the elderly population, females, and homemakers. Its onset was associated with a change in the frequency of bowel movement, sensation of incomplete or hardly any evacuation, and the use of manual maneuvers, which are consequential clinical symptoms of FC. Subjects with FC also frequently skipped breakfast, had insufficient sleep, had more severe constipation, and had purchased laxatives in pharmacies or online more often than individuals without FC. A strong awareness of constipation was significantly more prevalent among women and homemakers. A history of anemia and cardiovascular disease was significantly more frequent in the strong awareness group, whereas a history of hypertension was more frequent in the weak awareness group.

Conclusions: Based on the understanding of the characteristic features of FC, appropriate and comprehensive management considering the patient's symptoms and lifestyle should be provided.

Background

The definition and diagnostic criteria for chronic constipation have been recently updated in the Rome IV criteria.[1] According to this classification, functional constipation (FC) is diagnosed when two or more of the following six symptoms are present — "straining during at least 25% of defecations", "lumpy or hard stools (type 6 or 7 on the Bristol stool scale)",[2, 3] "sensation of incomplete evacuation," "sensation of anorectal obstruction," "manual maneuvers to facilitate defecation," and "fewer than three defecations per week" — and when both following conditions are met — "loose stools rarely present without use of laxatives" and "does not meet Rome IV criteria for irritable bowel syndrome (IBS)". These conditions must be met for the past 3 months, with symptom onset of at least 6 months prior to diagnosis.[4] Japan's Clinical Guidelines for Chronic Constipation 2017 defined constipation as a "state in which feces that should be eliminated from the body cannot be passed in sufficient quantity and in comfort" and explained that it can "cause symptoms requiring examination and treatment due to reduced frequency of defecation (e.g. abdominal pain, abdominal bloating, etc.), hard stools (e.g. difficulty in defecating, excessive straining during defecation, etc.), or evacuation disorder (e.g. difficulty in defecating even loose stools, excessive straining during defecation, sensation of incomplete evacuation and therefore frequent defecation)." It has been reported to affect 1−27% of the population, with the wide range attributed to variations on the population studied, definition used, and evaluation method.[4] Chronic constipation is a

disease of high prevalence, characterized by gastrointestinal symptoms frequently encountered in different medical specialties and not only in gastroenterology.[5] A study on the impact of various functional gastrointestinal disorders, including constipation, on survival reported that subjects with chronic constipation had a significantly higher risk for poorer survival than subjects with other disorders. Therefore, constipation should not be taken lightly.[6] Prior to the establishment of guidelines, initial diagnoses and treatment approaches were based on the physician's individual experience. Thus, there is limited information on the prevalence and actual disease status of patients with constipation. Moreover, few patients consult with constipation as their chief complaint. Patients with constipation tend to self-medicate using over-the-counter (OTC) medications or implement their own lifestyle modifications.[5, 7, 8, 9] This is due to the fact that constipation is not regarded as a disease,[10] there is no clear definition or diagnostic criteria for chronic constipation, and an initial diagnosis and treatment approach are based on clinical experience. Although evidence-based management of constipation has recently been promoted since the publication of the Clinical Guidelines for Chronic Constipation 2017,[4] only a few large-scale implementations have been reported thus far.[8, 11, 12] In Japan, there are only two existing reports[8, 13] on the public awareness of constipation and its actual incidence, as well as the medication use and quality of life (QOL) of patients with constipation. Therefore, much remains unknown about the epidemiology of FC and its background, such as the status of constipation, medication, and treatment satisfaction. Here, we performed an online survey to determine the actual FC situation in Japan, investigating the frequency of symptoms, background factors, treatment, and QOL.

In Japanese subjects with awareness of constipation, the frequency and FC-related factors according to the Rome III criteria[14] were studied in comparison with subjects with non-functional constipation (non-FC). The factors associated with a strong awareness of constipation were also studied.

Methods

Subjects

The survey was conducted on October 8–11, 2016, among 10,000 panelists aged 20–69 years from the general population who were registered with Rakuten Insight (Osaka, Japan), an internet survey company. All survey participants gave their informed consent. Valid answers were received from 9,523 subjects, and 4,908 (51.5%) of these subjects responded to the question "Do you think you have constipation?" with "I strongly think I have constipation" or "I think I have constipation." Of 4,908 subjects with awareness of constipation, 3,000 were randomly extracted by fitting the general population composition ratio by prefecture, sex, and age, which was considered to reflect the demographic profile in Japan as estimated by the Statistics Bureau, Ministry of Internal Affairs and Communications of Japan as of October 1, 2014.

Exclusion criteria

The following subjects were excluded from the survey: subjects with organic diseases such as cancer and inflammatory diseases, neurological diseases, endocrine disorders, and secondary constipation

induced by medication (e.g. opioids, antidepressants, anticholinergic agents, calcium blockers, proton pump inhibitors, etc.).

Survey

The information elicited from each study participant are as follows: age, sex, educational history, occupation, residence, history of other diseases, lifestyle, which included smoking/drinking habits using the Japanese Health Practice Index (JHPI), medication use, symptoms of constipation according to the Rome III criteria,[14] stool types according to the Bristol stool scale,[2, 3] and use of laxatives, including the place of purchase and cost per month or acceptable cost per month. Participants also took an 8-item Short Form Health Survey Questionnaire (SF-8).[15] FC was diagnosed based on Rome III criteria,[14] which differed from the Rome IV criteria on the diagnosis of IBS in that chronic abdominal pain or discomfort is experienced at least 3 days per month instead of at least 1 day per week.

Of the 3,000 participants extracted, those who answered "I think so" to the question "Do you usually think that you have constipation?" were classified into the strong awareness group and the rest were classified into the weak awareness group. A comparative study was conducted for both groups.

Statistical analysis

The level of significance of the statistical analysis was set at $P < 0.05$ (two-sided). The two-sided 95% confidence interval was calculated where appropriate. To calculate the confidence interval of a proportion and the 95% confidence interval of a proportion of cases, the exact method (Clopper-Pearson) based on F-distribution was used. Unpaired t-tests were used to compare continuous data between the two groups. We used Fisher's exact test to compare categorical (nominal) variables and investigate whether the proportions of one variable are different from the values of another variable. In addition, we used pairwise comparisons between proportions, with Benjamini-Hochberg adjustment of the P values, to further investigate which categories of the nominal variables showed significant differences. Logistic regression with awareness of constipation as a dependent variable was used to analyze factors related to awareness of constipation. For multivariate analysis, all variables were entered using forced entry. The Cochran-Armitage trend test was used to evaluate stool form by cost per month or acceptable cost per month.

Results

Comparison of functional and non-functional constipation in the Japanese population

Background factors

Of the 3,000 subjects extracted, 262 subjects (8.7%) were classified into the FC group and 2,738 subjects (91.3%) were classified into the non-FC group (Table 1). The percentage of women was significantly

higher in the FC group than in the non-FC group (72.1% and 47.8%, respectively; $P < 0.001$). Similarly, the mean age was significantly higher in the FC group (49.8 ± 13.1 vs. 45.8 ± 13.3 years; $P < 0.001$). The demographic trend showed a higher occurrence of FC in older populations, with a significantly higher frequency in individuals aged 60 and older than in other age groups (Figure 1A). The non-FC group had a significantly higher body mass index (BMI) than the FC group (21.7 ± 3.6 vs. 21.0 ± 3.3 kg/m^2, respectively; $P = 0.02$); however, the BMI in both groups was lower than the national average.

A higher proportion of subjects in the non-FC group than in the FC group answered that they were either office workers (46.2% vs. 39.3%, respectively; $P = 0.030$) or retired/unemployed (16.0% vs. 11.1%; $P = 0.030$), whereas there were significantly more homemakers in the FC group than in the non-FC group (27.5% vs. 14.4%, respectively; $P < 0.001$). Finally, the non-FC group had higher proportions of individuals with a history of type 2 diabetes mellitus (7.2% vs. 1.1%; $P < 0.001$), hypertension (13.8% vs. 9.5%; $P = 0.060$), anemia (17.1% vs. 13.7%; $P = 0.190$), and hyperlipidemia (11.4% vs. 9.5%; $P = 0.410$), as well as past treatment history of hypertension with hypertensive drugs (10.1% vs. 5.3%; $P = 0.010$) and cardiovascular disease (3.0% vs. 0.4%; $P = 0.010$). However, significant differences were only noted in the history of type 2 diabetes mellitus and in the past treatment history of hypertension with hypertensive drugs and cardiovascular disease.

Lifestyle

The JHPI lifestyle survey revealed that the occurrence of a past weight gain ≥ 10 kg was significantly more frequent in the non-FC group than in the FC group (23.0% vs. 17.2%; $P = 0.036$). No association was found between FC and drinking, smoking, eating, walking, or exercising. A strong awareness of constipation was a significant factor for not having FC (Table 1).

Quality of life

The evaluation of the QOL of participants using the SF-8 questionnaire[15] revealed that subjects in the FC group had a significantly higher mental component summary (MCS) than those in the non-FC group (46.7 ± 8.3 vs. 44.4 ± 9.2, respectively; $P < 0.001$), which included vitality (VT, feeling exhausted), social functioning (SF, having problems with family or friends), role emotional (RE, having difficulty in work or daily activity for psychological reasons), and mental health (MH, being nervous or depressed) (Table 1).

Clinical symptoms

A comparison of the two groups based on the Rome III criteria revealed that the following conditions occurred significantly more frequently in subjects in the FC group than in the non-FC group: straining, hard stool, sensation of incomplete evacuation, sensation of anorectal obstruction, rare bowel movements without the use of laxatives, and manual maneuvers to facilitate support of the pelvic floor at least 25% of defecation (Table 1). Loose stools that are rarely present without the use of laxatives is a

Rome III criterion for FC, and all FC subjects (100%) affirmed this symptom compared with only 30.8% of non-FC subjects ($P < 0.001$). Although there was no significant difference between the groups in the use of manual maneuvers (6.9% vs. 5.3% in the FC and non-FC groups, respectively; $P = 0.254$), very few used manual maneuvers to facilitate defecation. A significantly lower percentage of subjects with FC had stool corresponding to Bristol stool scale type 4 (i.e. normal stool) compared with those without FC (12.2% vs. 26%, respectively; $P < 0.001$) (Figure 2).

Source of laxative and acceptable cost

A significantly higher proportion of FC subjects used laxatives compared with non-FC subjects (53.4% vs. 28.7%; $P < 0.001$). While no significant difference was found between the groups on the laxative purchase by a physician's prescription, laxative purchase in pharmacies, and laxative purchase online, these were more common in the FC group (Figure 3). There was significantly more variation among FC subjects in terms of the amount they were willing to pay for laxatives ($P < 0.001$), and they paid a significantly higher amount than non-FC subjects ($P < 0.001$) (Figure 4).

Significant background factors

Factors found to be significant for the FC group in the univariate analysis were subjected to multivariate logistic regression analysis using a detection rate of $\leq 0.2\%$. Age, sex, and some clinical symptoms based on Rome III criteria, including sensation of incomplete evacuation for at least 25% of defecation, sensation of hard evacuation, and manual maneuvers to facilitate support of the pelvic floor at least 25% of defecation, were found to be significant background factors related to FC. Factors found to be significant for the non-FC were onset associated with a change in frequency of stool and Bristol stool type 4. (Table 2).

Comparison between strong and weak awareness of constipation

Background factors

The survey participants (n = 3,000) were also classified into either strong awareness or weak awareness of constipation. A strong awareness was significantly more prevalent in women than in men (57.3% vs. 42.7%; $P < 0.001$) (Table 3). A stronger awareness of constipation was observed among men in their 40s (Figure 1B). The average BMI was significantly higher in the weak awareness group; however, the subjects in both groups had a mean BMI lower than the national average in Japan.

A higher proportion of subjects in the weak awareness group answered that they were retired or unemployed than in the strong awareness group (17.0% vs. 14.0%; $P = 0.030$), whereas there were

significantly more homemakers in the strong awareness group (17.5% vs. 13.9%; $P = 0.006$). Additionally, the strong awareness group had a significantly higher level of education, with a bachelor's degree or over (52.3% vs. 39.7%; $P = 0.020$).

A past medical history of anemia (19.3% vs. 14.7%; $P < 0.001$) and cardiovascular disease (3.5% vs. 2.1%; $P = 0.030$) were significantly more frequent in the strong awareness group than in the weak awareness group, whereas a history of hypertension (14.7% vs. 11.8%; $P = 0.020$) was more frequent in subjects with weak awareness of constipation (Table 3).

Lifestyle

The evaluation of lifestyle using the JHPI survey showed that subjects with weak awareness of constipation "exercise aerobically for ≥30 minutes twice a week for at least 1 year" and "walk faster than other people of the same age" more frequently than subjects with strong awareness of constipation. Subjects with strong awareness of constipation have "dinner within 2 h before going to sleep ≥ 3 times a week", a "snack after dinner ≥ 3 times a week", "skip breakfast ≥ 3 times a week," and do not "get enough sleep" significantly more frequently, implying that subjects with an unhealthy lifestyle had a strong awareness of constipation.

Quality of life

The evaluation of the QOL of participants using the SF-8 questionnaire revealed that subjects with a weak awareness of constipation had a significantly higher MCS (45.1 ± 8.7, vs. 44.0 ± 9.7; $P < 0.001$) and physical component summary (PCS) than those with a strong awareness of constipation (Table 3).

Clinical symptoms

A comparison of the two groups based on the Rome III criteria revealed that the following conditions occurred significantly more frequently in subjects with strong awareness of constipation: straining, hard stool, sensation of incomplete evacuation, anorectal obstruction, manual maneuvering to facilitate evacuation, and rare bowel movements without the use of laxatives (Table 3).

Subjects with a strong awareness of constipation had a significantly higher percentage of stools corresponding to Bristol stool scale types 6 and 7, whereas those with a weak awareness had types 4 (normal stool) and 5 (Figure 2).

Significant background factors

Significant factors for strong awareness in the univariate analysis were subjected to multivariate logistic regression analysis using a detection rate of ≤ 0.2%. The female sex, sensation of incomplete evacuation

for at least 25% of defecations, sensation of hard evacuation, and loose stools rarely present without the use of laxatives were found to be significant background factors related to a strong awareness of constipation. On the other hand onset associated with a change in frequency of stool, Bristol stool type 4 were associated with weak awareness of constipation. (Table 4).

Discussion

The characteristic features of FC were evaluated based on the responses of subjects extracted according to the Japanese population composition ratio, excluding those with organic diseases and those using antidepressants or other medications for the treatment of thyroid diseases, diabetes mellitus, or hypertension, which can induce secondary constipation. A study on the long-term prognosis of constipation based on population composition ratio, excluding patients with cancer and comorbidities, showed that constipation is associated with a high mortality rate.[6] However, the prognosis and the prognostic factors for FC have not been elucidated. In the present study, FC was found predominantly in women, individuals with a low BMI, and the elderly (aged 60–69 years). While all members of the FC group reported difficulty in having bowel movements without laxatives, 30% of the subjects in the non-FC group also reported this symptom. Among the lifestyle factors, the only significant difference between groups was the past weight gain of ≥10 kg in the non-FC subjects; thus, no association between lifestyle and FC was detected. Interestingly, a strong awareness of constipation was considered a significant risk factor for FC (Table 1). The healthy lifestyle habits of exercising > 30 min twice a week and walking faster than other people of the same age were significantly less common in subjects with strong awareness of constipation than in those with weak awareness. Additionally, the unhealthy habits of having late dinners (i.e. 2 h before sleep), getting snacks after dinner at least three times a week, skipping breakfast at least three times a week, and getting insufficient sleep were significantly more common in subjects with strong awareness. On the other hand, evaluation of QOL using the SF-8[15] revealed that subjects with non-FC had significantly lower scores for the vitality, social functioning, role emotional, and mental health subscales, whereas subjects with FC had significantly higher MCS. Irritable bowel syndrome (IBS-C) is known to have a strong negative impact on psychological status,[16, 17] and the results of this study confirmed that FC is associated with a lower psychological impact than IBS-C. It was also noted that a significantly higher percentage of subjects with FC were female and homemakers, and there were more office workers, retirees, and unemployed subjects in the non-FC group. Constipation is known to be prevalent in women of reproductive age.[18] Anatomically, Japanese women are said to have longer colons.[19] Nevertheless, a comparison of the colorectal length between American and Japanese men and women over 50 years of age revealed that there was no significant difference in colorectal length between men and women and between Japanese and American individuals. Therefore, constipation in females or in specific ethnic groups cannot be associated with a greater colorectal length.[20] In the present study, the male to female ratio of subjects in their 60s was equal in the FC and non-FC groups (data not shown), which suggests an association between FC and women of reproductive age.

As for the purchase of laxatives, a significantly higher percentage of subjects with FC used laxatives, purchased either in pharmacies and online, and considered ≥1000 to ≥5000 yen as an acceptable cost per month for the treatment of FC without a prescription. Widely available OTC laxatives often cause significant irritation of the gastrointestinal tract,[21] and appropriate medical advice from a physician is still recommended for symptom relief in both IBS-C and FC. Some researchers have suggested placing IBS-C and FC within the same disease spectrum, and while the relationship between gut microbiota and IBS-C has been investigated,[21] further studies need to be conducted to determine whether the same relationship exists between FC and gut microbiota.[16] The prevalence of chronic constipation according to the Rome III criteria is reported to be 5.5% in an online survey conducted in the USA and 2.1% based on medical consultations in Japan.[13, 16] According to the 2017 Comprehensive Survey of Living Conditions in Japan,[22] constipation is more prevalent in women than in men. However, at the age of > 70 years, the number of men with constipation increases, and at the age of ≥ 80 years, the occurrences in men and women are approximately equal.

Awareness of constipation seems to stem from the subjective experience of its symptoms as well as from objective indices, such as stool frequency and consistency, which are noted by a physician. Symptoms such as straining, sensation of incomplete evacuation, and sensation of anorectal obstruction are included in the Rome IV criteria[1] and Clinical Guidelines for Chronic Constipation.[4] Therefore, it is important that the physician takes these symptoms fully into account during a clinical consultation. There may also be a dysuria-type constipation, suggesting an imbalance in the defecation muscles or rectal pooling. A detailed evaluation of the chief complaint through careful history-taking may lead to a correct diagnosis of constipation.

Those who have a strong awareness of constipation more often complained of incomplete defecation and hard stools (n = 1119, 82.2%). The infrequent reports of normal stools indicate a higher prevalence of incomplete bowel movements. Perhaps due to this, subjects feel that a good bowel movement is rare without the aid of laxatives; thus, laxative use increases. This study shows that weak constipation awareness and good lifestyle are related, as shown in people who have good health habits (i.e. walk faster than people of the same age, do not eat midnight snacks, do not skip breakfast, and have sufficient sleep) and who are less likely to have constipation are consequently less aware of the condition. The fact that the number of people who are weakly aware of constipation involving defecation being rare without laxative use was significantly lower proved that lifestyle-related habits relieve the symptoms of constipation (Table 4). This item of loose stools being rare without laxatives must be met, secondary constipation must be eliminated, and only 262 of 3000 patients were diagnosed with FC. However, 55.3% to 82.2% of participants answering questions about the Rome III criteria (other than the two manual questions) answered that these items were applicable, demonstrating their usefulness for diagnosing chronic constipation (Table 3).

The present survey was performed over the Internet, where the risk of impersonation cannot be eliminated completely. However, we believe in the reliability of the respondents, who were registered panelists and

whose identities can be confirmed by the survey company. The population surveyed consists of 3,000 subjects who were randomly extracted according to the population composition ratio by prefecture, sex, and age, thus reflecting the demographic profile in Japan. Nonetheless, since the upper age limit was set at 70 years in consideration of internet use among the elderly, further studies need to be conducted for the generalization of these results on Japanese subjects aged 70 years and over. Despite the aforementioned limitations, internet surveys are highly useful in performing cross-sectional studies on the actual status of certain conditions or issues due to the advantage of obtaining answers directly from participants, without any intervention or bias from healthcare personnel. Moreover, there is a shorter data collection period for a larger population size that is reflective of the population composition ratio.

Conclusion

The prevalence of FC as a form of chronic constipation is low in subjects representative of the Japanese population. It occurs often in thin subjects and in women, and in those with a strong awareness of the condition. The QOL is only slightly reduced; thus, patients with FC do not typically regard their constipation symptoms as serious health concerns. Patients with FC tend to have an irregular lifestyle, purchase laxatives in pharmacies, and are willing to pay a higher amount for OTC remedies, which shows a predisposition to treat their condition on their own. Based on an understanding of these characteristic features of FC, appropriate treatment should be provided while primarily considering the patient's symptoms and lifestyle. Patients should be well-informed about their condition and the corresponding plan of intervention to ensure that appropriate management of constipation is made widely available.

Abbreviations

functional constipation (FC)

irritable bowel syndrome (IBS)

over-the-counter (OTC)

quality of life (QOL)

Japanese Health Practice Index (JHPI)

Short Form-8 questionnaire (SF-8 questionnaire)

general health (GH)

physical functioning (PF)

role functioning (RF)

bodily pain (BP)

vitality (VT)

social functioning (SF)

mental health (MH)

role emotional (RE)

physical component summary (PCS)

mental component summary (MCS)

body mass index (BMI)

Declarations

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Tables

Table 1. Univariate analysis of characteristics of subjects in the functional constipation (FC) and non-FC groups, expressed in frequency or mean ± standard deviation (SD).

Items		FC (n = 262)	Non-FC (n = 2,738)	P value*
Residential area: North (Tohoku, Hokkaido)/East (Kanto, Tokai, Koshinetsu)/West (Kinki, Chugoku, Shikoku, Kyushu), n/n/n		33/128/101	298/1,483/959	0.250
Age, years (mean ± SD)		49.8 ± 13.1	45.8 ± 13.3	<0.001**
Sex, female, n (%)		189 (72.1)	1,308 (47.8)	<0.001**
BMI, kg/m^2 (mean ± SD)		21.0 ± 3.3	21.7 ± 3.6	0.002**
Jobs and education				
Employment status, n (%)	Student	10 (3.8%)	34 (1.2%)	0.360
	Office worker	103 (39.3%)	1,266 (46.2%)	0.030**
	Self-employed	21 (8.0%)	216 (7.9%)	0.900
	Part-time worker	36 (13.7%)	389 (14.2%)	0.930
	Retired or unemployed	29 (11.1%)	439 (16.0%)	0.030**
	Homemaker	72 (27.5%)	394 (14.4%)	<0.001**
Education, n (%)	Junior high school or high school	129 (49.2%)	1,218 (44.5%)	0.150
	Bachelor's degree or higher	132 (50.4%)	1,506 (55.0%)	0.150
Past history of disease				
Hypertension, n (%)		25 (9.5%)	377 (13.8%)	0.060

Type 2 diabetes mellitus, n (%)	3 (1.1%)	196 (7.2%)	<0.001**
Hyperlipidaemia, n (%)	25 (9.5%)	313 (11.4%)	0.410
Lesion in the stomach, duodenum or small intestine, n (%)	0	291 (10.6%)	NA
Inflammatory bowel disease, n (%)	0	0	-
Hemorrhoids, n (%)	0	395 (14.4%)	NA
Diverticulum, n (%)	0	35 (1.3%)	NA
Gastrointestinal cancer, n (%)	0	0	-
Cerebrovascular disease, n (%)	0	60 (2.2%)	NA
Chronic obstructive pulmonary disease, n (%)	0	5 (0.2%)	NA
Liver disease, n (%)	0	62 (2.3%)	NA
Kidney disease, n (%)	0	62 (2.3%)	NA
Abdominal surgery without appendectomy, n (%)	0	0	-
Anemia, n (%)	36 (13.7%)	468 (17.1%)	0.190
Past treatment history			
Hypertensive drugs, n (%)	14 (5.3%)	276 (10.1%)	0.010**
Insulin injections or hyperglycemia drugs, n (%)	0	123 (4.5%)	NA
Hyperlipidemia drugs, n (%)	22 (8.4%)	264 (9.6%)	0.580
Cerebrovascular disease, n (%)	0	80 (2.9%)	NA
Cardiovascular disease, n (%)	1 (0.4%)	81 (3.0%)	0.010**
Chronic renal failure or history of dialysis, n (%)	0	26 (0.9%)	NA
Depression or anxiety, n (%)	0	314 (11.5%)	NA
Lifestyle factors based on JHPI questionnaire			

Smoking more than 100 cigarettes per month and smoking for 6 month or longer, n (%)	41 (15.6%)	39 (1.4%)	0.580
Alcohol drinking occasionally or daily, n (%)	156 (59.5%)	1,046 (38.2%)	0.900
Walking for 1 h/d, n (%)	100 (38.2%)	1,027 (37.5%)	0.730
Body weight gain of at least 10 kg, n (%)	45 (17.2%)	630 (23.0%)	0.036**
Exercising for more than 30 minutes twice a week for at least 1 year, n (%)	57 (21.8%)	564 (20.6%)	0.630
Walking or similar exercise for more than 1 h/d, n (%)	56 (21.4%)	567 (20.7%)	0.610
Walking faster than other people of the same age, n (%)	97 (37.0%)	1,038 (37.9%)	0.790
Body weight gain or loss of at least 3 kg within 1 year, n (%)	86 (32.8%)	928 (33.9%)	0.780
Eating faster than other people, n (%)	100 (38.2%)	1,027 (37.5%)	0.730
Having dinner within 2 h before going to sleep at least 3 times a week, n (%)	67 (25.6%)	794 (29.0%)	0.290
Eating snacks after dinner at least 3 times a week, n (%)	83 (31.7%)	797 (29.1%)	0.390
Skipping breakfast at least 3 times a week, n (%)	69 (26.3%)	715 (26.1%)	0.940
Insufficient sleep, n (%)	144 (55.0%)	1,588 (58.0%)	0.350
Strong awareness of constipation, n (%)	71 (27.1%)	1,171 (42.8%)	<0.001**
Rome III criteria question items			

Improvement with defecation, n (%)	194 (74.0%)	1,933 (70.6%)	0.255
Onset associated with a change in frequency of stool, n (%)	133 (50.8%)	1,613 (58.9%)	0.013**
Onset associated with a change in form (appearance) of stool, n (%)	137 (52.3%)	1,577 (57.6%)	0.103
Straining during at least 25% of defecation, n (%)	211 (80.5%)	1,828 (66.8%)	<0.001**
Lumpy or hard stool at least 25% of defecations, n (%)	210 (80.2%)	1,682 (61.4%)	<0.001**
Sensation of incomplete evacuation for at least 25% of defecation, n (%)	230 (87.8%)	1,828 (66.8%)	<0.001**
Sensation of hard evacuation, n (%)	255 (97.3%)	2,036 (74.4%)	<0.001**
Manual maneuvers to facilitate digital evacuation at least 25% of defecation, n (%)	18 (6.9%)	144 (5.3%)	0.254
Manual maneuvers to facilitate support of the pelvic floor at least 25% of defecation, n (%)	62 (23.7%)	321 (11.7%)	<0.001**
Loose stools are rarely present without the use of laxatives, n (%)	262 (100.0%)	843 (30.8%)	<0.001**
Quality of life (SF-8)			
GH[†] (mean ± SD)	46.9 ± 7.5	46.1 ± 7.8	0.121
PF[‡] (mean ± SD)	47.2 ± 9.5	46.9 ± 9.0	0.532
RP[§] (mean ± SD)	48.6 ± 7.1	47.9 ± 7.9	0.158
BP[¶] (mean ± SD)	48.5 ± 8.3	48.3 ± 8.6	0.655

VT[††] (mean ± SD)	48.1 ± 7.4	46.5 ± 7.9	0.002**
SF[‡‡] (mean ± SD)	47.9 ± 9.1	45.9 ± 10.2	0.002**
MH[§§] (mean ± SD)	48.9 ± 7.7	47.2 ± 8.3	0.001**
RE[¶¶] (mean ± SD)	45.0 ± 10.5	43.1 ± 10.9	0.010**
PCS[†††] (mean ± SD)	46.9 ± 7.1	46.9 ± 7.5	0.966
MCS[‡‡‡] (mean ± SD)	46.7 ± 8.3	44.4 ± 9.2	<0.001**

*The level of significance is set at $P < 0.05$.

**Significant difference between groups.

[†]GH, general health; [‡]PF, physical functioning; [§]RP, role physical; [¶]BP, body pain; [††]VT, vitality; [‡‡]SF, social functioning; [§§]MH, mental health; [¶¶]RE, role emotional; [†††]PCS, physical component summary; [‡‡‡]MCS, mental component summary.

Table 2. Multivariate analysis of background factors significant for functional constipation (FC).

Items	Univariate				Multivariate			
	Odds	95% CI		*P* value*	Odds	95% CI		*P* value*
Age	1.023	1.013	1.033	<0.001**	1.032	1.020	1.045	<0.001**
Sex (female = 1)	0.353	0.267	0.468	<0.001**	0.380	0.260	0.498	<0.001**
BMI	0.942	0.906	0.980	0.003**				
Jobs and education								
Office worker	0.753	0.581	0.976	0.032**				
Retired or unemployed	0.677	0.449	1.023	0.064				
Homemaker	2.255	1.685	3.018	<0.001**				
Bachelor's degree or higher	0.634	0.485	0.827	<0.001**				
Past history of disease								
Hypertension	0.629	0.414	0.956	0.030**				
Type 2 diabetes mellitus	0.150	0.048	0.473	0.001**	0.191	0.058	0.627	0.006**
Dyslipidaemia	0.689	0.459	1.034	0.072				
Anaemia	0.213	0.149	0.305	<0.001**	0.173	0.119	0.252	<0.001**
Rome III criteria question items								
Improvement with defecation	1.188	0.891	1.585	0.241				
Onset associated with a change in frequency of stool	0.719	0.558	0.927	0.011**	0.689	0.477	0.996	0.048**
Onset associated with a change in	0.807	0.626	1.040	0.098				

form or appearance of stool								
Straining during at least 25% of defecation	2.060	1.502	2.825	<0.001**				
Lumpy or hard stool at least 25% of defecations	2.535	1.854	3.468	<0.001**				
Sensation of incomplete evacuation for at least 25% of defecation	3.578	2.451	5.223	<0.001**	1.953	1.283	2.974	0.002**
Sensation of hard evacuation	12.56	5.899	26.744	<0.001**	8.152	3.600	1.846	<0.001**
Manual maneuvers to facilitate digital evacuation at least 25% of defecation	1.329	0.801	2.208	0.271				
Manual maneuvers to facilitate support of the pelvic floor at least 25% of defecation	2.334	1.716	3.176	<0.001**	1.587	1.123	2.241	0.009**
Loose stools are rarely present	-	-	-	-	-	-	-	-

without the use of laxatives								
Bristol stool type 4	0.395	0.270	0.578	<0.001**	0.585	0.386	0.888	0.012**
Source of laxative								
History of laxative use	5.851	4.341	7.886	<0.001**				
Pharmacy	2.684	2.056	3.505	<0.001**				
Internet	2.103	1.446	3.015	<0.001**				
Acceptable laxative cost								
More than 1000 yen	1.806	1.384	2.357	<0.001**				

*The level of significance is set at $P < 0.05$.

**Significant difference between groups.

Table 3. Univariate analysis of characteristics of subjects with strong or weak awareness of constipation, expressed in frequency or mean ± standard deviation (SD).

Items		Strong awareness of constipation (n = 1,362)	Weak awareness of constipation (n = 1,638)	*P* value*
Residential area	North (Tohoku, Hokkaido)/East (Kanto, Tokai, Koshinetsu)/West (Kinki, Chugoku, Shikoku, Kyushu), n/n/n	136/736/490	193/875/570	0.280
Age	Years, (mean ± SD)	46.3 ± 12.9	46.0 ± 13.8	0.500
Sex	Female, (%)	57.3	48.8	<0.001**
BMI	kg/m^2 (mean ± SD)	21.4 ± 3.6	21.8 ± 3.5	0.001**
Jobs and education		n	n	
Jobs, n (%)	Student	15 (1.1%)	20 (1.2%)	0.850
	Office worker	619 (45.4%)	750 (45.8%)	0.870
	Self-employed	108 (7.9%)	129 (7.9%)	>0.999
	Part-time worker	191 (14.0%)	234 (14.3%)	0.870
	Retired or unemployed	190 (14.0%)	278 (17.0%)	0.030**
	Homemaker	239 (17.5%)	227 (13.9%)	0.006**
Education, n (%)	Junior high school, High school	647 (47.5%)	715 (43.7%)	0.010**
	Bachelor's degree or over	712 (52.3%)	650 (39.7%)	0.020**
Past history of disease		n	n	
Hypertension, n (%)		161 (11.8%)	241 (14.7%)	0.020**
Type 2 diabetes mellitus, n (%)		90 (6.6%)	95 (5.8%)	0.360
Hyperlipidemia, n (%)		153 (11.2%)	185 (11.3%)	>0.999
Lesion in the stomach, duodenum or small intestine, n (%)		131 (9.6%)	160 (9.8%)	0.900
Inflammatory bowel disease, n (%)		0	0	
Hemorrhoids, n (%)		161 (11.8%)	234 (14.3%)	0.051
Diverticulum, n (%)		11 (0.8%)	24 (1.5%)	0.120

Gastrointestinal cancer, n (%)	0	0	
Cerebrovascular disease, n (%)	32 (2.3%)	28 (1.7%)	0.240
Chronic obstructive pulmonary disease, n (%)	1 (0.1%)	4 (0.2%)	0.400
Liver disease, n (%)	27 (2.0%)	35 (2.1%)	0.800
Kidney disease, n (%)	31 (2.3%)	31 (1.9%)	0.520
Abdominal surgery without appendectomy, n (%)	0	0	
Anemia, n (%)	263 (19.3%)	241 (14.7%)	<0.001**
Past treatment history			
Hypertensive drugs, n (%)	123 (9.0%)	167 (10.2%)	0.290
Insulin injections or hyperglycemia drugs, n (%)	59 (4.3%)	64 (3.9%)	0.580
Hyperlipidemia drugs, n (%)	145 (10.6%)	141 (8.6%)	0.060
Cerebrovascular disease, n (%)	43 (3.2%)	37 (2.3%)	0.140
Cardiovascular disease, n (%)	47 (3.5%)	35 (2.1%)	0.030**
Chronic renal failure or history of dialysis, n (%)	12 (0.9%)	14 (0.9%)	>0.999
Depression or anxiety, n (%)	157 (11.5%)	157 (9.6%)	0.090
Lifestyle factors based on JHPI questionnaire			
Smoking more than 100 sticks per month, n (%)	197 (14.5%)	236 (14.4%)	0.920
Alcohol consumption, n (%)	804 (59.0%)	998 (60.9%)	0.310
Body weight increased by 10 kg or more from the age of 20, n (%)	315 (23.1%)	359 (21.9%)	0.430
Exercising for more than 30 minutes twice a week for at least 1 year	259 (19.0%)	360 (22.0%)	0.040**
Walking for 1 h/d, n (%)	520 (38.2%)	614 (37.5%)	0.730
Walking faster than other people of the same age, n (%)	463 (34.0%)	621 (37.9%)	0.030**

Eating faster than other people, n (%)	520 (38.2%)	614 (37.5%)	0.730
Having dinner within 2 h before going to sleep at least 3 times a week, n (%)	417 (30.6%)	442 (27.0%)	0.030**
Eating snacks after dinner at least 3 times a week, n (%)	439 (32.2%)	441 (26.9%)	0.002**
Skipping breakfast at least 3 times a week, n (%)	379 (27.8%)	405 (24.7%)	0.060
Insufficient sleep, n (%)	821 (60.3%)	909 (55.5%)	0.010**
Rome III criteria question items			
Improvement with defecation, n (%)	964 (70.8%)	1,163 (71.0%)	0.904
Onset associated with a change in frequency of stool, n (%)	789 (57.9%)	957 (58.4%)	0.795
Onset associated with a change in form or appearance of stool, n (%)	753 (55.3%)	961 (58.7%)	0.064
Straining during at least 25% of defecation, n (%)	989 (72.6%)	1,050 (64.1%)	<0.001**
Lumpy or hard stool at least 25% of defecations, n (%)	933 (68.5%)	959 (58.5%)	<0.001**
Sensation of incomplete evacuation for at least 25% of defecation, n (%)	1,040 (76.4%)	1,018 (62.1%)	<0.001**
Sensation of hardly any evacuation, n (%)	1,119 (82.2%)	1,172 (71.6%)	<0.001**
Manual maneuvers to facilitate digital evacuation at least 25% of defecation, n (%)	95 (7.0%)	67 (4.1%)	0.001**
Manual maneuvers to facilitate support of the pelvic floor at least 25% of defecation, n (%)	222 (16.3%)	161 (9.8%)	<0.001**
Loose stools are rarely present without the use of laxatives, n (%)	753 (55.3%)	352 (21.5%)	<0.001**
Quality of life (SF-8)			
GH[†] (mean ± SD)	45.5 ± 8.1	46.8 ± 7.4	<0.001**

PF‡ (mean ± SD)	46.2 ± 9.8	47.5 ± 8.3	<0.001**
RP§ (mean ± SD)	47.6 ± 8.2	48.3 ± 7.6	0.003**
BP¶ (mean ± SD)	47.9 ± 8.9	48.5 ± 8.3	0.041**
VT†† (mean ± SD)	46.0 ± 8.2	47.2 ± 7.5	<0.001**
SF‡‡ (mean ± SD)	45.4 ± 10.8	46.6 ± 9.4	<0.001**
MH§§ (mean ± SD)	46.6 ± 8.8	48.0 ± 7.7	<0.001**
RE¶¶ (mean ± SD)	43.0 ± 11.1	43.5 ± 10.6	0.169
PCS††† (mean ± SD)	46.5 ± 7.8	47.3 ± 7.1	0.003**
MCS‡‡‡ (mean ± SD)	44.0 ± 9.7	45.1 ± 8.7	0.001**

*The level of significance is set at $P < 0.05$.

**Significant difference between groups.

†GH, general health; ‡PF, physical functioning; §RP, role physical; ¶BP, body pain; ††VT, vitality; ‡‡SF, social functioning; §§MH, mental health; ¶¶RE, role emotional; †††PCS, physical component summary; ‡‡‡MCS, mental component summary.

Table 4. Multivariate analysis of background factors significant for strong awareness of constipation.

Items	univariate				multivariate			
	Odds	95% CI		*P* value*	Odds	95% CI		*P* value*
Age	1.002	0.996	1.007	0.558				
Sex (female), %	0.581	0.502	0.672	<0.001**	0.729	0.614	0.867	<0.001**
BMI	0.970	0.950	0.990	0.004**				
Jobs and education								
Office worker	0.986	0.854	1.140	0.853				
Retired or unemployed	0.726	0.588	0.895	0.003**				
Homemaker	1.323	1.085	1.612	0.006**				
Bachelor's degree or over	0.730	0.631	0.844	<0.001**	0.849	0.721	1.000	0.050**
Past history of disease								
Hypertension	0.794	0.646	0.976	0.029**	0.692	0.545	0.878	0.003**
Diabetes	1.083	0.812	1.444	0.589				
Dyslipidemia	0.994	0.810	1.219	0.952				
Anemia	1.141	0.985	1.321	0.078				
Rome III criteria question items								
Improvement with defecation	0.989	0.845	1.159	0.894				
Onset associated with a change in frequency of stool	0.980	0.847	1.134	0.784				
Onset associated with a change in form or	0.871	0.753	1.007	0.062	0.783	0.664	0.924	0.004**

appearance of stool								
Straining during at least 25% of defecation	1.485	1.270	1.736	<0.001**				
Lumpy or hard stool at least 25% of defecations	1.450	1.324	1.790	<0.001**				
Sensation of incomplete evacuation for at least 25% of defecation	1.967	1.676	2.308	<0.001**	1.457	1.202	1.790	0.001**
Sensation of hard evacuation	1.831	1.536	2.182	<0.001**	1.301	1.022	1.654	0.033**
Manual maneuvers to facilitate digital evacuation at least 25% of defecation	1.759	1.276	2.435	<0.001**				
Manual maneuvers to facilitate support of the pelvic floor at least 25% of defecation	1.786	1.438	2.220	<0.001**				
Loose stools are rarely present without the use of laxatives	4.516	3.852	5.295	<0.001**	4.070	3.439	4.817	<0.001**
Bristol stool type 4	0.398	0.333	0.476	<0.001**	0.549	0.450	0.671	<0.001**

Source of laxative				
History of laxative use	2.887	2.483	3.358	<0.001**
By prescription	1.572	1.329	1.859	<0.001**
Pharmacy	1.375	1.189	1.590	<0.001**
Internet	1.561	1.210	2.013	<0.001**
Acceptable laxative cost				
More than 1000 yen	2.083	1.762	2.482	<0.001**

*The level of significance is set at $P < 0.05$.
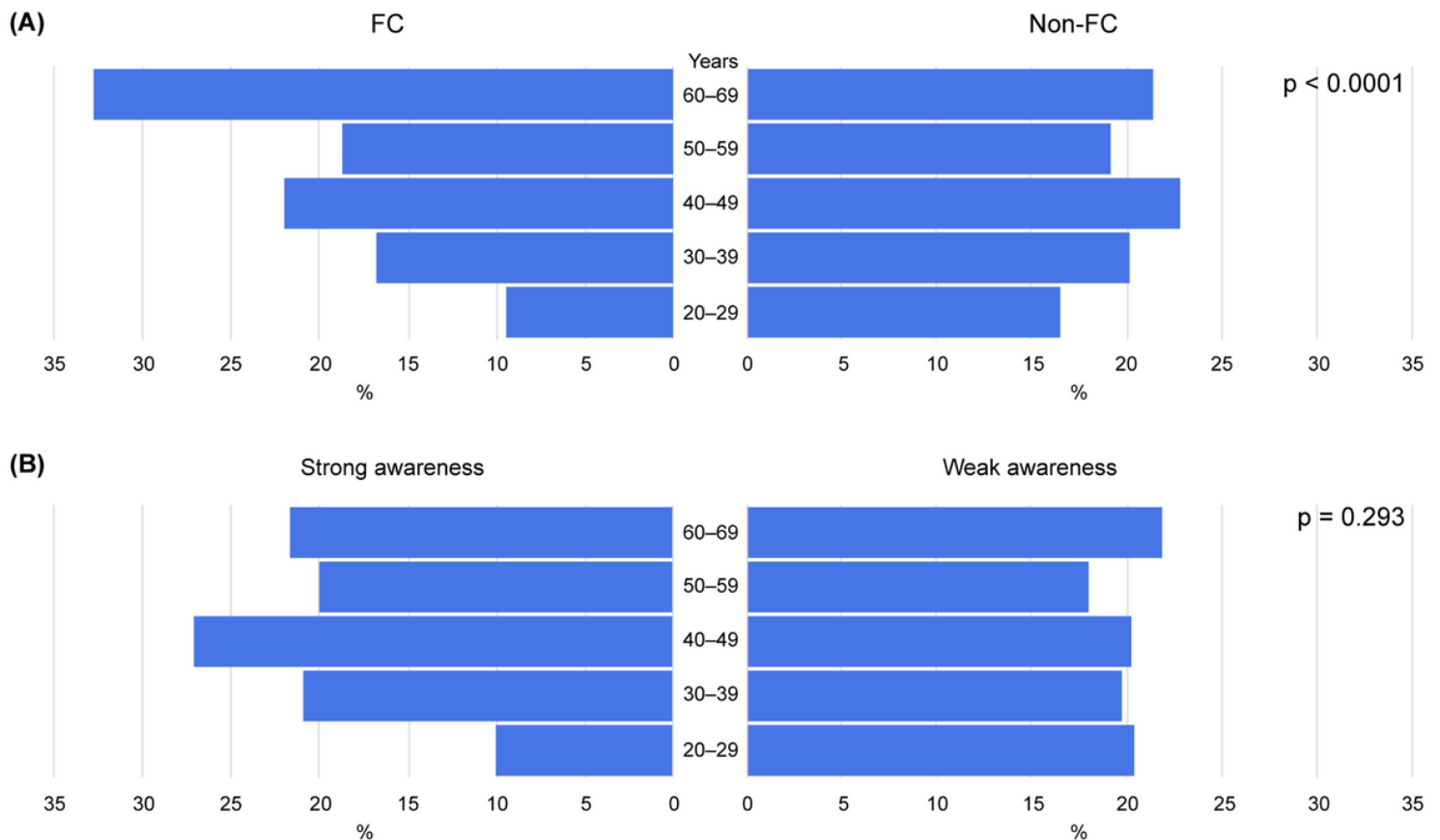
**Significant difference between groups.

Figures

Figure 1

Age trends. Comparison of age range between FC and non-FC (A) and between strong awareness and weak awareness of constipation (B).
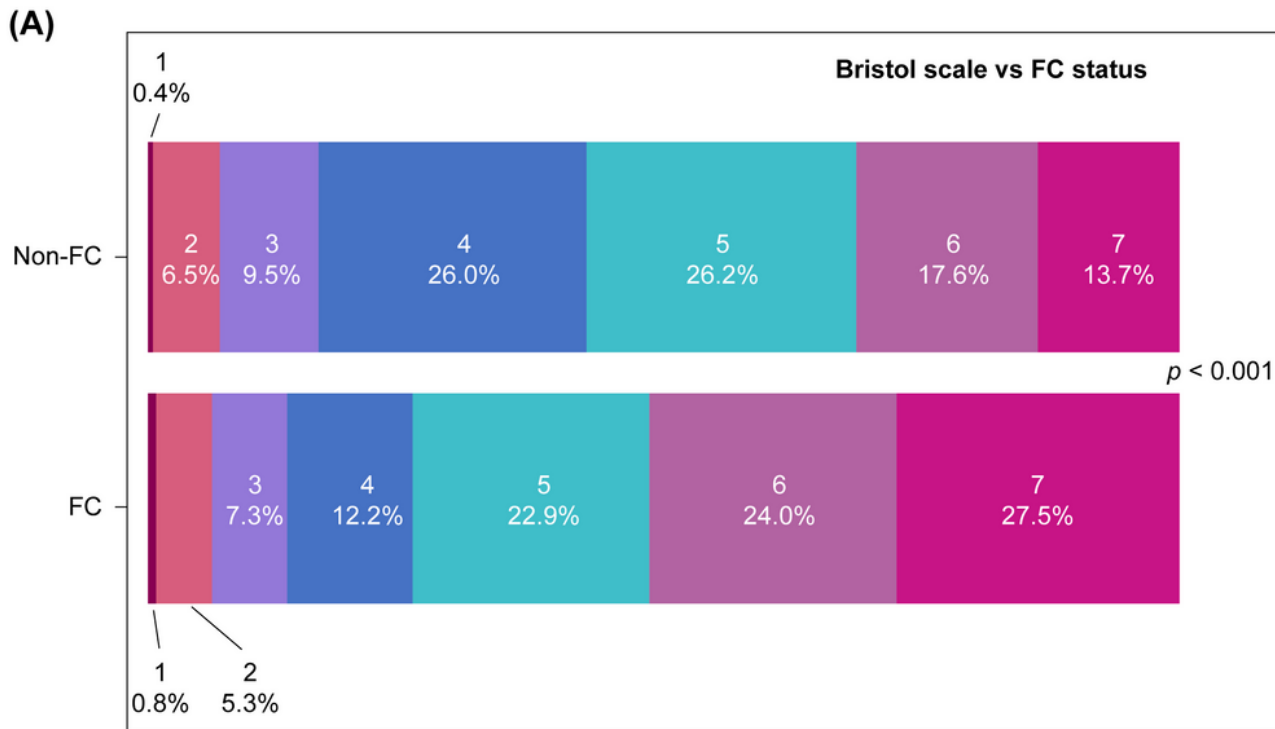
(A)

(B)
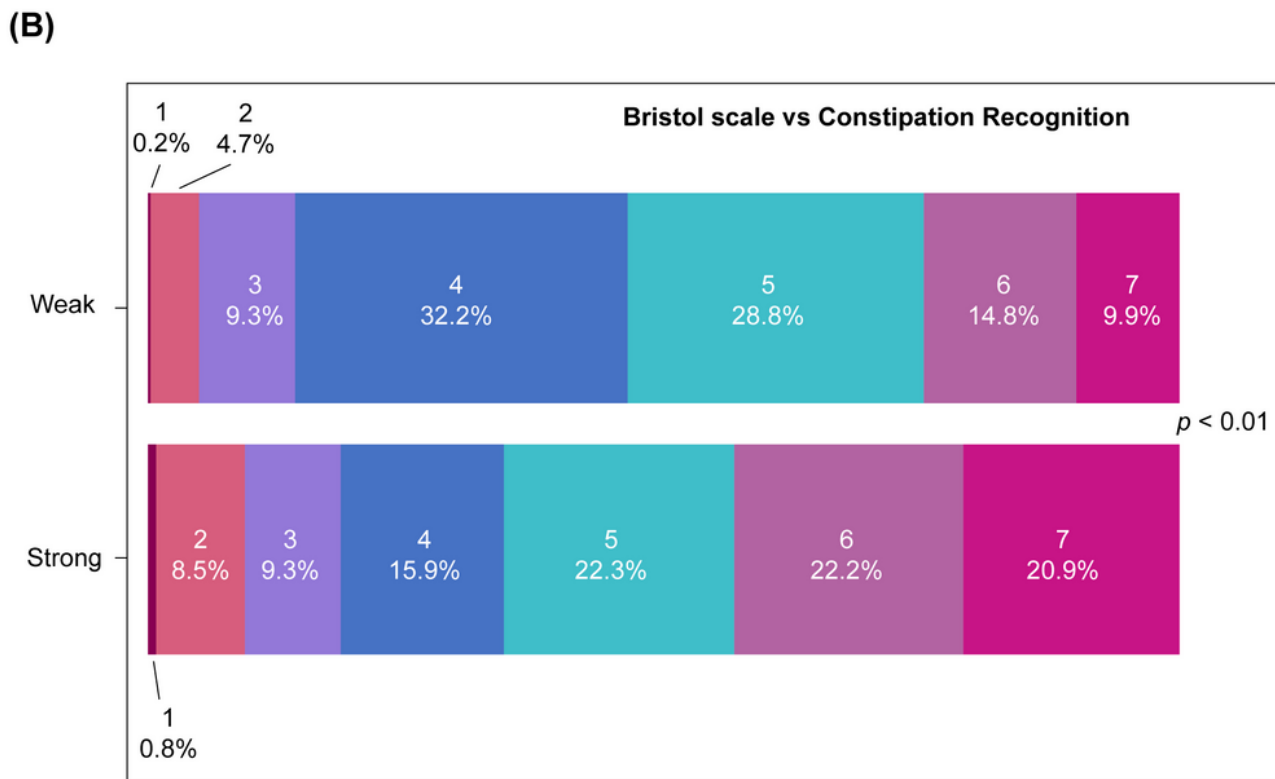
Figure 2

Bristol scale. Comparison of stool types between FC and non-FC (A) and between strong awareness and weak awareness of constipation (B). 1: Watery, no solid pieces; 2: fluffy pieces with ragged edges, a mushy stool; 3: soft blobs with clear cut, smooth and soft, passed early; 4: like sausage or snake, smooth

and soft; 5: like sausage but with cracks on surface; 6: sausage shaped but lumpy; 7: shaped hard lumps, like nuts, hard to pass.
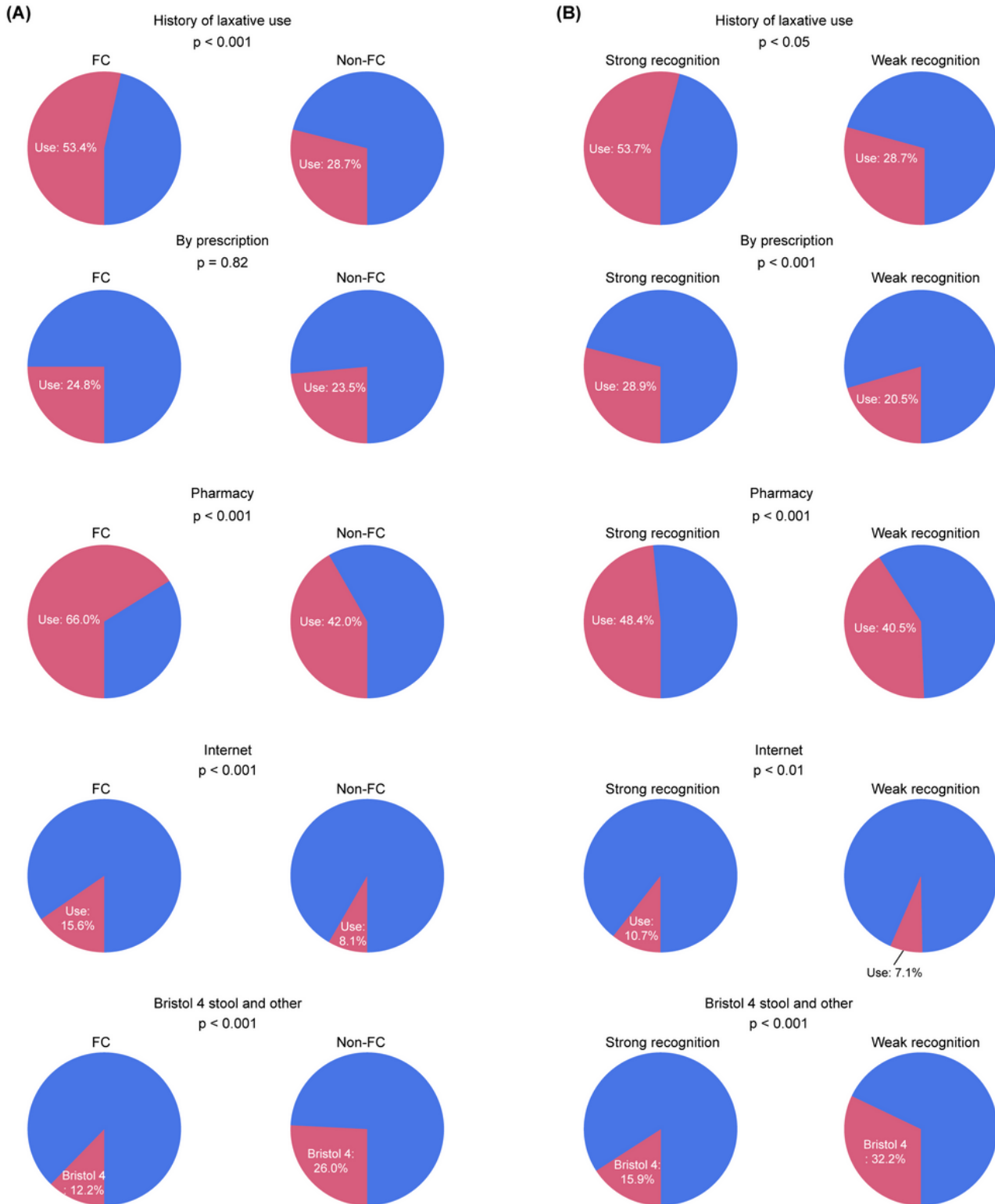

Figure 3

History of laxative use. Comparison of laxative purchase. Comparison of Bristol 4 stool scale between functional constipation (FC) and non-FC; and (A) between strong awareness and weak awareness of constipation (B).
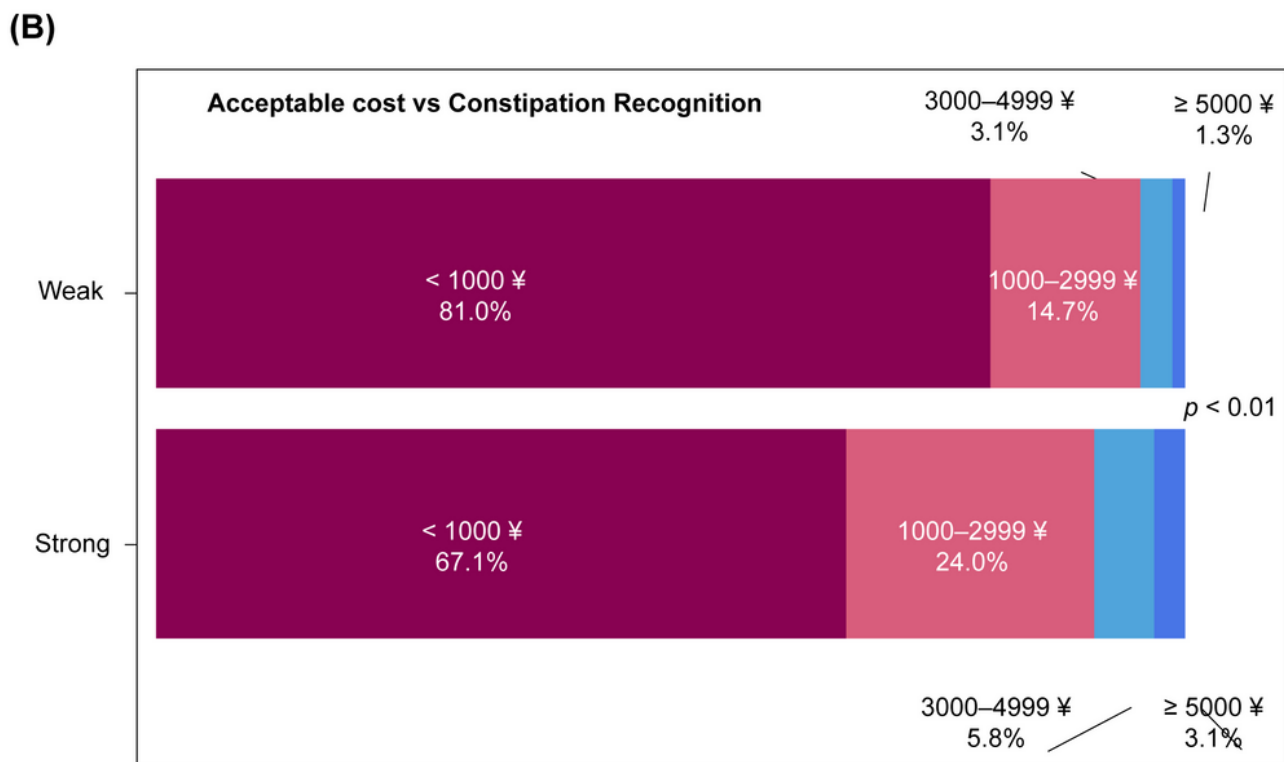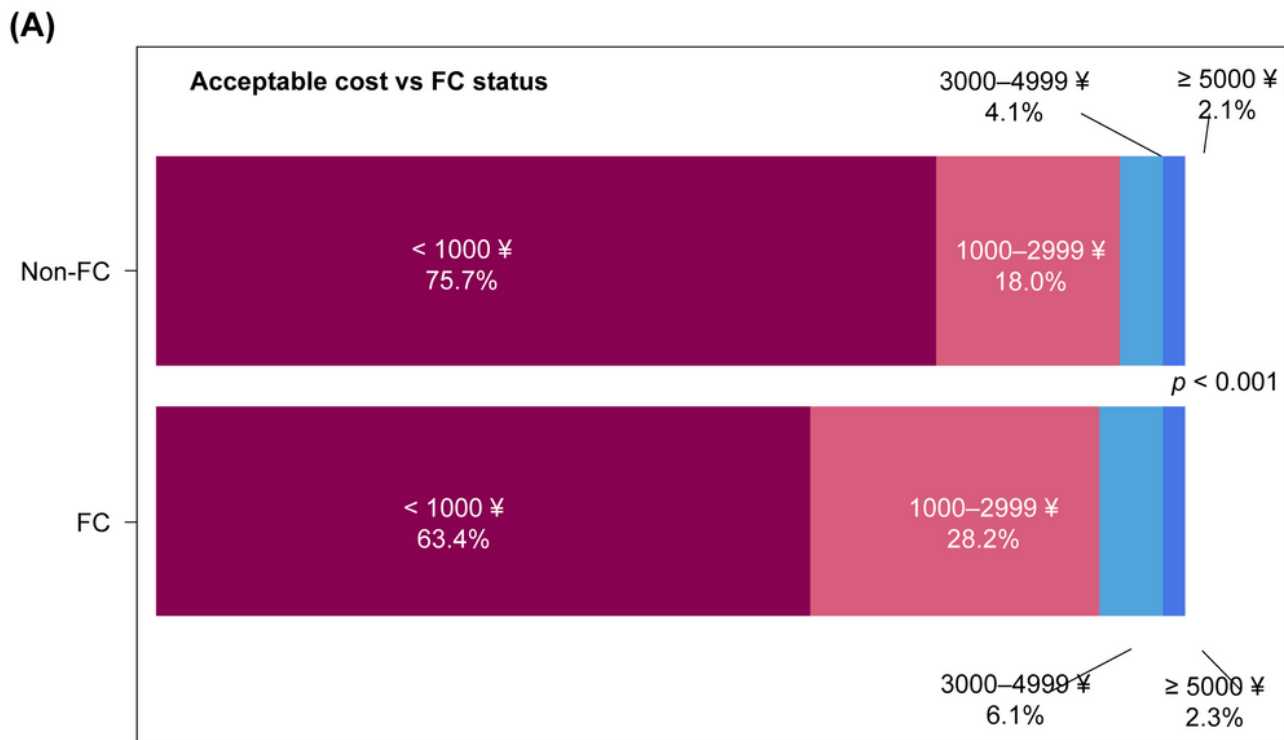
(A)

(B)

Figure 4

Acceptable cost of laxatives. Comparison of cost of laxatives between FC and non-FC (A) and between strong awareness and weak awareness of constipation (B).