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Self-Reported Food Triggers and Food Fears Impact Nutrient Intake and Quality of Life in Patients with Irritable Bowel Syndrome and Functional Dyspepsia

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Background/Aims: Self-reported food triggers are common in patients with irritable bowel syndrome (IBS) and functional dyspepsia (FD), often leading to dietary restrictions which can be exacerbated by "fear of food." This study aimed to evaluate the frequency of self-reported food triggers and food-related fears in IBS and FD patients and assess their impact on nutrient intake and health-related quality of life (HRQoL).
Methods: Patients meeting Rome IV criteria for IBS or FD, along with healthy controls (HCs), were enrolled. Dietary intake was assessed using a validated questionnaire; food-related fear using the 'Fear of Food Questionnaire-18', and HRQoL using the PROMIS Global-10 tool.
Results: Total 811 participants (FD: 244, IBS: 160, HCs: 407; mean age: 42.3±12.3 years; males: 58.5%) were included. IBS and FD patients reported significantly more food triggers than HCs, the most frequent being spicy/fried foods in FD (50.4%) and constipation-predominant IBS (39.7%), and milk in diarrhoea-predominant IBS (70.1%). Total intake of energy, protein, fat, carbohydrates, and FODMAPs was significantly lower in IBS and FD patients compared to HCs. Food-related fear scores were significantly higher in IBS and FD patients and showed a strong correlation with both the number of food triggers and reduced nutrient intake. Food triggers negatively impacted HRQoL, both directly and indirectly, through food-related fear.
Conclusions: Patients with IBS and FD report significantly more food triggers which correlates with reduced macronutrient and FODMAP intake. Food-related fear is strongly associated with diminished nutrient consumption and lower HRQoL. These findings highlight the importance of personalized psychological and dietary interventions in management of IBS and FD. **(Korean J Gastroenterol 2025;85:345-356)**

Key Words: Functional gastrointestinal disorders; Food intolerance; Irritable bowel syndrome; Functional dyspepsia; Food hypersensitivity

INTRODUCTION

Disorders of gut-brain interaction (DGBI), formerly known as functional gastrointestinal disorders, are among the most common conditions encountered in gastroenterology clinics worldwide.[1] These disorders significantly affect the health-related quality of life (HRQoL) and contribute to substantial healthcare utilization.[2,3] Functional dyspepsia (FD) and irritable bowel syndrome (IBS) are the two most prevalent forms of DGBI, with a multifactorial pathophysiology involving motility disturbances, visceral hypersensitivity, immune dysregulation, changes in the gut microbiota, and central nervous system

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dysfunction.[1,4-6] Psychological factors modulate the symptom severity and disease burden, necessitating a multimodal management approach.[1,6-9]

Dietary factors play an important role in exacerbating or alleviating symptoms in patients with DGBIs.[6,10,11] Self-reported food intolerances/food triggers have been reported more frequently in IBS and FD patients than in healthy controls (HCs).[10,12] Many of these patients eliminate multiple food items/food groups from their diet in the pursuit of symptom improvement.[13,14] Although dietary modification can be an effective symptom management strategy in the short term, indiscriminate food avoidance may lead to multiple nutritional deficiencies.[13,14] Moreover, whether food itself is the primary driver of symptoms is unclear. More recently, the role of food-related fear in shaping dietary patterns has attracted attention. Patients with IBS and FD often experience heightened concern about food intake, leading to excessive dietary restrictions independent of their true physiological intolerance.[10,15-17] This fear-driven avoidance behavior may reinforce maladaptive eating patterns, exacerbate nutritional compromise, and adversely affect HRQoL.[18] The psychological burden of food-related fear is recognized as a critical determinant in the clinical presentation and dietary choices of patients with DGBI.[18]

Among the dietary interventions suggested for IBS and FD patients, the low fermentable oligosaccharide, disaccharide, monosaccharide, and polyol (FODMAP) diet has promise in alleviating the symptoms in DGBI patients.[19] Several randomized controlled trials, including one from the authors' group, reported the short-term efficacy of a low FODMAP diet in improving symptoms and HRQoL in IBS patients.[20-22] Emerging data also indicate potential benefits in FD.[23,24] Nevertheless, the long-term efficacy and sustainability of LFD remain uncertain. Adherence is often difficult, and the prolonged restriction of FODMAP-containing foods can lead to nutritional deficiencies, gut microbiota alterations, and further compromise the HRQoL.[19] Data on habitual FODMAP intake in IBS and FD patients compared to HCs are inconsistent, with some studies reporting lower intake in affected individuals while others finding no significant difference.[20] Therefore, studies are needed to determine if increased FODMAP consumption is responsible for symptoms or patients with IBS and FD experience symptoms even with a normal FODMAP intake caused by visceral hypersensitivity.[20,25,26]

Beyond the macronutrient composition, the psychological response to food plays a pivotal role in symptom perception and dietary choices. Food-related fear, which leads to an excessive avoidance of consuming specific food items caused by anticipated symptom exacerbation, has increasingly been recognized as a major determinant of dietary restriction.[18] The development and validation of the Fear of Food Questionnaire-18 (FFQ-18) have provided a structured approach to assessing this phenomenon.[18] Despite this, limited data exist on the association between food-related fear, habitual nutrient intake, and HRQoL in IBS and FD patients.

This study examined the frequency of self-reported food triggers and food fears in IBS and FD patients and evaluated their impact on the nutrient intake and HRQoL. Furthermore, this study compared the habitual macronutrient and FODMAP intake among IBS, FD, and HC groups and explored the relationship between dietary factors, symptom severity, and HRQoL. The interplay between diet, food-related fear, and HRQoL in IBS and FD patients was examined by addressing these gaps, which may ultimately guide the planning of personalized psychological and dietary interventions.

SUBJECTS AND METHODS

1. Study design and setting

This prospective observational study was conducted in the outpatient department of an academic institute in India over a 12-month period after gaining approval from the institutional ethics committee. Written informed consent was obtained from all participants in their vernacular language, ensuring comprehension.

2. Study participants

The participants were recruited based on pre-defined inclusion and exclusion criteria. The eligible cases included individuals between 18 and 70 years of age diagnosed with IBS or FD according to the Rome IV criteria. Individuals presenting with alarm symptoms, such as significant weight loss, nocturnal symptoms, anemia, gastrointestinal bleeding, or non-investigated new onset IBS or FD after 50 years of age, were excluded. The additional exclusion criteria included the presence of organic gastrointestinal (GI) diseases (e.g., Helicobacter pylori infection, celiac disease, and inflammatory bowel disease), a history of GI surgery, chronic use of non-steroidal anti-inflammatory drugs, significant comorbidities, or

psychiatric illnesses (Fig. 1). Patients on restrictive diets (e.g., LFD) or those with significant weight loss were also excluded because such conditions could confound dietary assessment.

The HCs were selected from age- and gender-matched individuals accompanying patients. The HCs were screened using the Rome IV diagnostic questionnaire to ensure they did not meet the IBS/FD criteria and had minimal GI symptoms (defined as abdominal symptoms with a frequency of no more than two days/month or abnormal bowel movements with a proportion of no more than 25% of defecations). Furthermore, it was ensured that HCs had no advanced systemic disorders or addictions. The baseline investigations required for including these cases and controls included a hemogram, fasting blood sugar, creatinine, alanine transaminase, aspartate transaminase, and thyroid-stimulating hormone levels, all performed within six months of presentation.

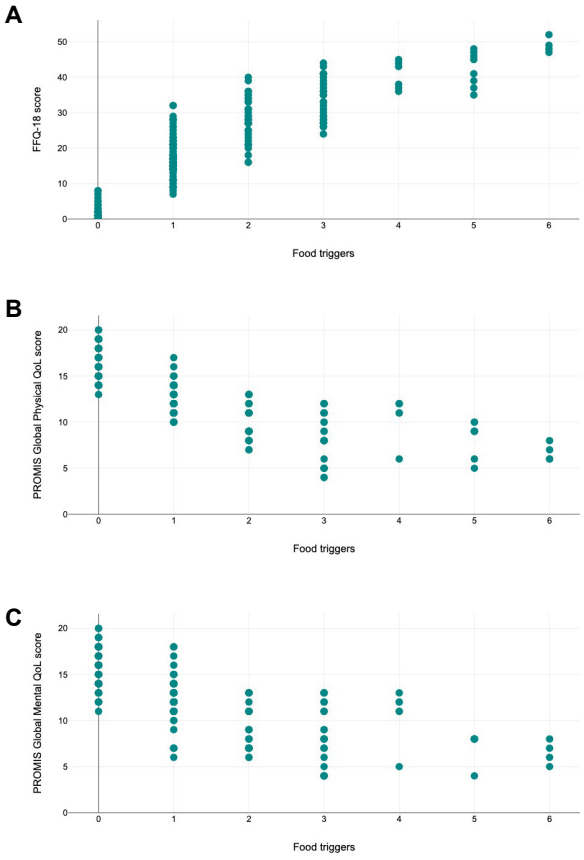


Fig. 1. Scatter plots depicting the relationships between (A) food triggers and fear of food (FFQ-18) scores (r=0.92, p<0.001), (B) food triggers and PROMIS Global Physical Quality of Life (QoL) scores (r=−0.81, p<0.001), and (C) food triggers and PROMIS Global Mental QoL scores (r=−0.86, p<0.001).

3. Study protocol and questionnaires

A structured protocol was followed to ensure standardized data collection. The socio-demographic details, medical history, and clinical data were recorded for all participants using a pre-designed questionnaire. In addition, the following questionnaires were used:

- Rome IV diagnostic questionnaire for adults for the diagnosis of FD and IBS.[1]
- IBS Severity Scoring System (IBS-SSS) to assess the severity of IBS symptoms.[27] The IBS-SSS included five visual analog scales relating to abdominal pain, abdominal distension, satisfaction with bowel habits (e.g., frequency and ease), and disease interference with life in general. The total score ranged from 0 to 500. Patients with scores <75, 75–175, 175–300, and >300 were considered to be in remission, having mild disease, having moderate disease, and having severe disease, respectively.
- Short-Form Nepean Dyspepsia Index (SF-NDI) symptom questionnaire to assess the severity of FD symptoms.[28] The frequency and intensity scores of EPS and PDS symptoms were added to calculate a composite score (ranging from 0 to 18; severe FD was defined as a score ≥8)
- Fear of Food Questionnaire-18 (FFQ-18) to evaluate food-related fear and avoidance behaviors.[18] (Supplementary Material 1). A score> 15 was taken as the presence of food fear.
- PROMIS Global 10 to assess the HRQoL.[29] (Supplementary Material 2)

The dietary patterns were evaluated using a combination of a 24-hour dietary recall and a food frequency questionnaire specifically validated for the northern Indian population.[30] The questionnaire captured the detailed habitual dietary intake, portion sizes, and frequencies of various food items consumed over the past month, excluding atypical periods such as fasting or festivals. Furthermore, potential food triggers were identified by asking the participants to report specific foods that exacerbated their symptoms. A food item was taken as a food trigger if a patient experienced gastrointestinal symptoms on at least three separate occasions, spaced at least one month apart, following the consumption of the suspected food. This definition ensured that the reaction was reproducible rather than incidental, strengthening the reli-

ability of self-reported food triggers.

4. Procedural details

The participants were provided detailed instructions to record their dietary intake accurately, including specific information on food brands, preparation methods, and portion sizes. Trained assessors guided the participants in completing the dietary questionnaires to ensure uniformity in data collection. For illiterate or physically disabled participants, the assessors read the questions aloud and recorded responses without introducing bias. Uniformity was ensured by having all participants complete the Rome IV questionnaire, IBS-SSS, and SF-NDI, including HCs, as part of the screening process. The dietary records were reviewed thoroughly by the research investigator blinded from the study to ensure completeness and accuracy.

5. Nutritional analysis

Nutritional analysis of the dietary data was conducted by trained nutritionists using established norms from the National Institute of Nutrition, India.[31] The macronutrient intake, including energy, protein, fat, and carbohydrate levels, was calculated for each participant. In addition, the mean daily FODMAP intake and its individual components were quantified using published reference data.[32-35]

6. Outcomes

The primary outcome was the difference in the frequency of self-reported food triggers in the IBS, FD, and HC groups. The secondary outcomes included the impact of food triggers on the FFQ-18 score and the HRQoL. Additional secondary outcomes included the differences in habitual macronutrients and FODMAP intake among IBS, FD, and HCs.

7. Statistical analysis

The categorical data are presented as proportions, and continuous data as mean and standard deviation. A t-test was used to compare the quantitative data, and Chi-Square or Fisher's exact test was used for qualitative data. The FFQ-18 and HRQoL scores of the IBS, FD, and HC groups were compared using ANOVA. Correlation analysis assessed the associations between food triggers, dietary intake of macronutrients and FODMAPS, symptom severity, FFQ-18 scores, and HRQoL scores. Mediation analysis was conducted to determine if the data were significant. Statistical analysis was performed using the statistical package of social sciences version 21 (IBM Co., Armonk, NY, USA). The methodology of the study adhered to the STROBE guidelines.

Table 1. Baseline Characteristics of the Study Population

Characteristics	HCs (n=407)	FD (n=244)	IBS-D/M (n=87)	IBS-C (n=73)
Age (years)	42.4±17.1	41.6±16.8	39.8±15.4	42.8±14.3
Male gender	252 (61.9)	139 (57.0)	51 (58.6)	47 (64.4)
BMI	24.2±3.1	25.1±3.3	22.9±3.8*	23.8±4.2
Urban residence	191 (46.9)	124 (50.8)	41 (47.1)	38 (52.1)
Educational level				
Uneducated	39 (9.6)	29 (11.9)	6 (6.9)	6 (8.2)
High school	153 (37.6)	82 (33.6)	32 (36.8)	29 (39.7)
Graduate	148 (36.4)	89 (36.5)	41 (47.1)	36 (49.3)
Postgraduate	67 (16.5)	44 (18.0)	8 (9.2)	2 (2.7)
Employment status				
Employed	298 (73.2)	167 (68.4)	57 (65.5)	51 (69.9)
Unemployed	109 (26.8)	77 (31.6)	30 (34.5)	22 (30.1)

Data are expressed as mean±standard deviation or number (percent).
FD, functional dyspepsia; HCs, healthy controls; IBS-C, irritable bowel syndrome-constipation predominant; IBS-D/M, irritable bowel syndrome-diarrhoea predominant/mixed.
*p-values for comparison between all sub-groups are non-significant except BMI in IBS-D/M group was significantly lower than HC (p=0.032).

RESULTS

1. Patient characteristics

Eight hundred and eleven participants were enrolled, including 244 FD patients, 160 IBS patients (87 had IBS-D/M, and 73 had IBS-C) (mean age 42.3±12.3 years; males 58.5%), and 407 HCs (mean age 42.4±17.1 years; males 61.9%). The baseline characteristics are summarized in Table 1. The BMI was significantly lower in the IBS-D/M patients than in the HCs, with no other significant socio-demographic differences between the three groups.

2. Comparison of food triggers

Among the FD patients, 68.4% (n=167) reported food triggers compared to 73.5% (n=64) of IBS-D/M and 47.9% (n=35) of IBS-C patients. In contrast, only 8.4% (n=34) of HCs reported food-related GI symptoms (dyspepsia, pain, bloating, or diarrhea) (Table 2). The most commonly reported triggers in FD patients were spicy/fried foods (123; 50.4%) and tea (121; 49.6%), whereas milk (61; 70.1%) and spicy/fried foods

Table 2. Self-reported Food Triggers in Healthy Controls, and Patients with Functional Dyspepsia and Irritable Bowel Syndrome

Food Item	HCs (n=407)	FD (n=244)	IBS-D/M (n=87)	IBS-C (n=73)	p-values		
					HC vs. FD	HC vs. IBS-D/M	HC vs. IBS-C
Milk	24 (5.9)	87 (35.7)	61 (70.1)	7 (9.6)	0.0001	0.0001	0.324
Tea	22 (5.4)	121 (49.6)	29 (33.3)	6 (8.2)	0.0001	0.0001	0.921
Coffee	9 (2.2)	17 (7.0)	5 (5.7)	1 (1.4)	0.003	0.082	0.736
Cheese	5 (1.2)	10 (4.3)	3 (3.4)	0 (0.0)	0.027	0.928	1
Butter	5 (1.2)	59 (24.2)	17 (19.5)	2 (2.7)	0.0001	0.0001	0.625
Curd	2 (0.5)	19 (7.8)	2 (2.3)	1 (1.4)	0.0001	0.114	0.875
Fried food	29 (7.1)	70 (28.7)	23 (26.4)	17 (23.3)	0.0001	0.0001	0.0001
Chilly/spicy food	21 (5.2)	123 (50.4)	37 (42.5)	29 (39.7)	0.0001	0.0001	0.0001
Pulses/Lentils[*]	11 (2.7)	21 (8.5)	18 (20.7)	5 (6.8)	0.0012	0.0001	0.175
Legumes[†]	16 (3.9)	67 (27.5)	29 (33.3)	11 (15.1)	0.0001	0.0001	0.0001
Cruciferous vegetables[‡]	9 (2.2)	27 (11.1)	17 (19.5)	4 (5.5)	0.0001	0.0001	0.121
Leafy vegetables[§]	11 (2.7)	26 (10.6)	21 (24.1)	3 (4.1)	0.0001	0.0001	0.062
Other vegetables[ǁ]	8 (2.0)	16 (6.4)	9 (10.3)	5 (6.8)	0.003	0.0001	0.033
Onion	11 (2.7)	22 (9.0)	16 (18.4)	1 (1.4)	0.002	0.0001	0.543
Garlic	4 (1.0)	3 (1.1)	2 (2.3)	0 (0.0)	1	0.285	1
Capsicum	2 (0.5)	61 (25.0)	18 (20.7)	1 (1.4)	0.0001	0.0001	0.087
Dry fruits (Almonds, nuts)	7 (1.7)	10 (4.3)	2 (2.3)	0 (0.0)	0.077	0.681	1
Fruits[**]	20 (4.9)	32 (13.1)	19 (21.8)	3 (4.1)	0.0001	0.0001	0.782
Fresh Juices	12 (2.9)	27 (11.1)	31 (35.6)	2 (2.7)	0.0001	0.0001	0.984
Sweets	31 (7.6)	41 (16.8)	21 (24.1)	12 (16.4)	0.0001	0.0001	0.024
Soft-drinks	9 (2.2)	5 (2.0)	12 (13.8)	0 (0.0)	0.833	0.0001	1
Rice	2 (0.5)	3 (1.1)	2 (2.3)	0 (0.0)	0.368	0.098	1
Wheat	0 (0.0)	0 (0.0)	2 (2.3)	0 (0.0)	1	1	1
Non-veg food	11 (2.7)	21 (8.5)	21 (24.1)	11 (15.1)	0.0001	0.0001	0.0001
Eggs	7 (1.7)	11 (4.5)	1 (1.1)	0 (0.0)	0.063	1	1

Data are expressed as number (percent).
FD, functional dyspepsia; HC, healthy controls; IBS-C, irritable bowel syndrome-constipation predominant; IBS-D/M, irritable bowel syndrome-diarrhoea predominant/mixed.
[*]Black Gram dal, Chana dal, Masoor dal, Green Gram dal.
[†]Beans, chickpeas, peanuts, tamarind, alfalfa, clover.
[‡]Broccoli, brussels sprouts, cabbage, cauliflower, turnip.
[§]Fenugreek leaves, Spinach, Cabbage.
[ǁ]Tomato, Brinjal, Bottle gourd, Ladies finger, Drumstick.
[**]Apple, Grapes, Watermelon, Papaya, Banana, Mango, Citrus Fruits.

(29; 39.7%) were the most common triggers in IBS-D/M and IBS-C, respectively. Among the HCs, 100% of subjects consumed wheat daily (two to three meals /day). Milk was consumed daily by 92.8% (378/407; median 300 mL/day), and a vegetarian diet was consumed by 60.7% (247/407) subjects.

3. Comparison of macronutrient and FODMAP intake

The IBS and FD patients exhibited significantly lower macronutrient intake than the HCs. The mean calorie intake in IBS subgroups was significantly lower than in the HCs (Table 3). The FD and IBS patients had a reduced mean protein intake, while fat consumption was significantly lower in the FD and IBS-D/M patients. Carbohydrate intake was significantly lower in IBS-D/M and IBS-C subgroups than the other groups, and IBS-D/M patients also had a markedly lower mean fiber intake. The total FODMAP intake was significantly lower across all disease subgroups than HCs (Table 3). Excluding excess fructose, the IBS and FD groups consumed significantly lower amounts of all other FODMAP components.

4. Correlation between symptom severity and food triggers

Correlation analysis between the symptom severity and the number of self-reported food triggers revealed interesting facts. A markedly strong positive correlation was observed between symptom severity and food triggers in the IBS-D/M subgroup ($r=0.88$, $p<0.001$), and a moderate-to-strong positive correlation in the IBS-C subgroup ($r=0.53$, $p<0.001$). Similarly, among the FD patients, a strong positive correlation was observed between the symptom severity and food triggers ($r=0.76$, $p<0.001$). These data indicate that patients with more severe symptoms report more food triggers than those with less severe symptoms.

When stratified according to the IBS symptom severity, IBS patients with severe symptoms (IBS-SSS≥300, n=59) were significantly more likely to report food triggers than those with mild-to-moderate symptoms (98.3% vs. 60.4%, $p<0.001$) (Supplementary Table 1). These patients also showed a substantially lower total energy and FODMAPs intake. A comparable trend was observed in FD patients, where individuals with severe symptoms (SF-NDI ≥8, n=98) reported food triggers more frequently than those with milder symptoms (100% vs. 52.7%, $p<0.001$), accompanied by significantly reduced consumption of total energy and FODMAPs.

5. Fear of food analysis

The mean 'fear of food' (FFQ-18) scores were significantly higher in the IBS and FD patients than in the HCs ($p<0.001$) (Supplementary Fig. 1). Among the IBS patients, the IBS-D/M patients exhibited the highest fear of food scores. The proportion of patients reporting 'fear of food' (defined as FFQ-18

Table 3. Comparison of Dietary Intake in Healthy Controls, Functional Dyspepsia, and IBS Subgroups

Food Item	HCs (n=407)	FD (n=244)	IBS-D/M (n=87)	IBS-C (n=73)	p-values		
					HC vs. FD	HC vs. IBS-D/M	HC vs. IBS-C
Macronutrients							
Energy (Kcal)	1,922.1±356	1,875.2±301	1,736.8±328	1,825±294	0.085	0.0001	0.028
Protein (g)	67.4±14.1	63.4±13.8	61.5±14.3	62.9±11.7	0.004	0.003	0.003
Fat (g)	55.4±9.1	53.3±6.4	48.7±7.1	54.7±7.9	0.002	0.0001	0.927
Carbohydrate (g)	292.1±67.8	284.8±48.3	258.3±54.5	269.1±44.7	0.103	0.0001	0.005
Fibre (g)	46.9±8.1	45.8±9.3	43.6±8.4	49.6±10.3	0.113	0.0001	0.34
FODMAPs							
Lactose(g)	15.1±4.2	13.8±3.9	12.2±2.7	15.7±5.8	0.001	0.001	0.29
Excess Fructose (g)	2.9±0.9	2.8±0.7	2.7±0.7	2.9±0.8	0.137	0.230	1.000
GOS (g)	0.91±0.47	0.83±0.41	0.72±0.47	0.75±0.38	0.027	0.001	0.002
Fructans (g)	2.9±1.1	2.2±0.9	2.1±0.8	2.3±0.8	0.001	0.001	0.038
Polyols (g)	0.64±0.31	0.59±0.29	0.58±0.33	0.61±0.35	0.042	0.016	0.041
Total FODMAP (g)	23.4±6.4	20.4±5.9	19.1±4.4	21.8±5.7	0.001	0.001	0.046

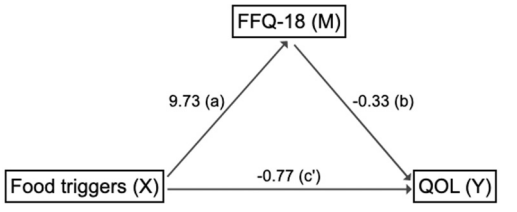
Data are expressed as mean±standard deviation.
FD, functional dyspepsia; FODMAP, fermentable oligo-, di-, mono-saccharides, and polyols; g, grams; GOS, galacto-oligosaccharides; HC, healthy controls; IBS-C, irritable bowel syndrome-constipation predominant; IBS-D/M, irritable bowel syndrome-diarrhoea predominant/mixed.

score >15) in the IBS D/M, IBSC, and FD sub-groups was significantly higher than the HC (61 [70.1%], 30 [41.1%], 104 [42.6%] and 0, respectively).

Correlation analysis showed a strong positive correlation between the number of food triggers and fear of food scores (r=0.91, p<0.001; Fig. 1A). Furthermore, patients reporting 'fear of food' (i.e., FFQ-18 scores >15) had a significantly lower total FODMAP (r=0.68; p<0.01), macronutrient intake (r=0.71; p<0.01), and calorie intake (r=0.69; p<0.01) than those who did not report a fear of food.

6. HRQoL analysis

The HRQoL scores (PROMIS Global 10-mental and physical components) were significantly lower in the IBS and FD patients than in the HCs (p<0.001), with IBS-D/M patients exhibiting the lowest scores among all sub-groups (Supplementary Fig. 2). A strong negative correlation was observed between the number of food triggers and the HRQoL scores (physical and mental components [r=–0.84, p<0.001; Fig. 1B, 1C]). Mediation analysis showed that the negative impacts of food triggers on HRQoL were direct and indirect, mediated through the fear of food (Fig. 2 and Table 4).



Variable	Effect	Standard Error	t	p-value
Total effect of X on Y	-3.95	0.17	-22.91	<.001
Direct effect of X on Y	-0.77	0.37	-2.08	0.038
Indirect effect of X on Y	-3.18	0.35	-9.2	0.0463
Effect of M on Y	-0.86	0.12	-2.54	<0.001

Fig. 2. Mediation analysis to study the relationships between food triggers, fear of food (FFQ-18), and health-related quality of life (HRQoL).

DISCUSSION

This study provides novel, comprehensive, and comparative data on self-reported food triggers, habitual macronutrient and FODMAP consumption, fear of food, and their impacts on the HRQoL in a large cohort of IBS and FD patients compared to the healthy controls. The IBS and FD patients reported food triggers significantly more often than the HCs, with the highest frequency observed in IBS-D/M (73. 4%) and FD (68.4%) sub-groups. Importantly, the fear of food and food-related anxiety (as assessed by the FFQ-18 questionnaire) emerged as a key determinant of dietary restrictions, with higher FFQ-18 scores linked to increased food avoidance, lower nutrient intake, and poorer HRQoL. These findings underscored the fact that dietary avoidance in IBS and FD may not always be physiologically driven but rather influenced by maladaptive food-related anxiety, potentially exacerbating nutritional deficiencies, symptom severity, and a poorer quality of life.

The high prevalence of self-reported food triggers in IBS and FD patients is consistent with previously published data.[10,12] Previous research identified fermentable carbohydrates, wheat-containing foods, and natural food chemicals as the major triggers for FD, while IBS symptom exacerbation has been linked to FODMAPs, histamine-releasing foods, fat-

Table 4. Table Depicting Spearman Correlation Coefficients Between Food Triggers, FFQ-18, Health Related Quality of Life (HRQoL) Domains (Physical and Mental)

Variables		Food triggers	FFQ-18	QoL Physical	QoL Mental
Food triggers	Correlation coefficient	1	0.92	–0.87	–0.78
	p-value		<0.001	<0.001	<0.001
FFQ-18	Correlation coefficient	0.92	1	–0.88	–0.8
	p-value	<0.001		<0.001	<0.001
QoL Physical	Correlation coefficient	–0.87	–0.88	1	0.92
	p-value	<0.001	<0.001		<0.001
QoL Mental	Correlation coefficient	–0.78	–0.8	0.92	1
	p-value	<0.001	<0.001	<0.001	

FFQ-18, fear of food questionnaire-18; HRQoL, health related quality of life.

ty/spicy foods, caffeine, and food additives.[10,12,14,16] In the present study, spicy food, tea, milk, and fried foods were the most frequently reported triggers in FD, while IBS-D/M patients most commonly reported milk, spicy food, fresh juices, tea, legumes, and fried foods, and IBS-C patients reported spicy and fried foods as triggers. Interestingly, self-reported wheat sensitivity (SRWS) was virtually absent in the present study population, which contrasts with data from Western studies but aligns with the findings from other South Asian cohorts.[12] This may be attributed to the lack of awareness about non-celiac gluten sensitivity (NCGS) among the general population in this region. Once celiac disease is excluded by serology or duodenal biopsies, the possibility of wheat being the trigger for the patient's symptoms is rarely considered. In addition, due to the habitual consumption of wheat in all three daily meals in the authors' region, individuals may not have a sufficient wheat-free interval to experience possible symptom improvement with its elimination. Consequently, patients may attribute symptoms more readily to other recognizable and culturally emphasized triggers such as spicy food, tea, and milk. Moreover, societal and economic constraints often preclude experimentation with a gluten-free diet unless medically indicated. Emerging data from the population has reported NCGS in up to one-fifth of patients with IBS and/or FD.[36,37] Future research should use structured double-blind placebo-controlled gluten challenge protocols to elucidate the true prevalence of NCGS and its clinical impact.

The data on the habitual FODMAP intake in IBS and FD patients compared to HC are limited and conflicting. Globally, the total mean FODMAP intake in HCs varies from 18.12 g/day to 21.6 g/day.[20,38] Although some studies reported lower FODMAP intakes in IBS /FD patients, others reported non-significant differences.[19,38] A significant finding in the present study is the markedly lower intake of macronutrients and FODMAPs in IBS and FD patients compared to HCs. These results align with a recent systematic review reporting that habitual FODMAP intake in IBS and FD patients tends to be significantly lower than in HCs (18.05 vs. 22.36 g/d).[20] Interestingly, the present study found that patients with severe symptoms were most likely to report food triggers and exhibit the lowest intake of macronutrients and FODMAPs. This raises the question of whether visceral hypersensitivity, rather than food ingestion per se, is the primary driver of the symptoms in these patients. Several mechanistic studies have shown that colonic hypersensitivity to luminal distension, rather than excessive fermentation of FODMAPs, underlie symptom generation in IBS patients.[39,40] This perspective supports the notion that addressing food-related anxiety and hypersensitivity mechanisms may be equally, if not more, important than dietary eliminations.

The analysis of macronutrient consumption in the present study showed that IBS-D/M patients had significantly lower calorie, carbohydrate, fat, and protein intake than HCs; IBS-C patients had significantly lower calorie, carbohydrate, and protein intake, while FD patients had significantly lower protein and fat intake. Most data regarding the differences in macronutrient intake between IBS and FD patients and HCs are not stratified according to the disease subtypes and are conflicting.[41-47] A recent meta-analysis including 29 studies reported no significant differences in the habitual intakes of macronutrients and micronutrients (except calcium) in adults with IBS compared to controls.[44] Nevertheless, the results of this metanalysis must be interpreted with caution because it included studies spanning from 1979 to 2022, which used seven different IBS diagnostic criteria. These data highlight the nutritional compromise IBS and FD patients face because of the avoidance of multiple food items.

Data on the fiber intake in IBS patients are conflicting and not stratified according to the IBS subtype.[44] In the present study, the fiber intake in IBS-C patients was significantly higher than in IBS-D/M patients. This might be due to the general recommendations by physicians to increase the fiber intake in patients with chronic constipation, as reported previously.[48,49] Nevertheless, excessive insoluble dietary fiber intake in IBS-C patients may paradoxically worsen bloating and abdominal discomfort.

One of the most novel contributions of the present study is the use of the FFQ-18 questionnaire to assess the fear of food and its impact on dietary intake. An FFQ-18 score >15 is indicative of the presence of "food fear," allowing the stratification of patients based on the severity of their food-related anxiety. A strong correlation was observed between the fear of food scores and the number of self-reported food triggers, reinforcing the role of food-related fears in self-imposed dietary restriction rather than true physiological intolerance. Furthermore, patients with high fear of food scores had significantly lower calorie, macronutrient, and FODMAP intake and poorer HRQoL. These findings suggest that the fear of

food can drive excessive dietary restriction, reinforcing a cycle of nutritional deficiency and impaired well-being. This contrasts with the findings of a few studies from Western populations, where the calorie intake was adequate despite multiple food triggers, possibly due to the greater awareness of dietary management strategies.[15]

A key takeaway from these findings is that food may not be the primary driver of symptoms in IBS and FD patients. Instead, food-related fears, maladaptive pain processing, and visceral hypersensitivity might be playing a major role. Although traditional elimination diets, such as gluten-free diets or low-FODMAP diets, have efficacy in reducing IBS/FD symptoms, long-term adherence to elimination diets is challenging. Moreover, encouraging indiscriminate food avoidance without addressing the psychological burden of food-related anxiety may worsen hypervigilance, leading to greater symptom distress and even conditioned food intolerance. This cycle of fear-driven restriction must be disrupted. Elevated FFQ-18 scores can help identify patients whose food-related anxiety compromises nutritional intake, quality of life, and psychosocial well-being. This supports the need for a paradigm shift from rigid elimination diets to structured food reintroduction, incorporating behavioral interventions to address food-related fears in IBS and FD patients.

Building on this, this paper proposes the following hypothesis. The perception of specific foods as symptom triggers initiates a maladaptive loop, where avoidance behavior and food-related fear contribute to reduced HRQoL (Fig. 3).

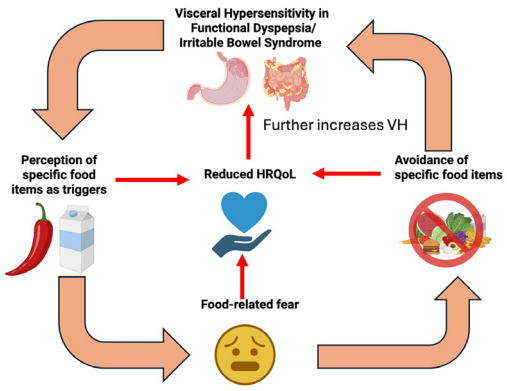


Fig. 3. Proposed hypothesis of a vicious cycle illustrating the impact of visceral hypersensitivity (VH) in functional dyspepsia (FD) and irritable bowel syndrome (IBS). VH may heighten the perception of certain foods as triggers, leading to avoidance, food-related fear, and reduced health-related quality of life (HRQoL), which may reinforce the VH, perpetuating the cycle.

This decline in HRQoL may amplify visceral hypersensitivity and central hypervigilance, increasing symptom sensitivity. Mechanistic evidence suggests that DGBI patients exhibit exaggerated responses to nutrient stimuli, with alterations in gut-brain signaling, immune activation, and the release of neuroactive mediators such as histamine and serotonin.[15] These biological changes, fueled by psychological distress, may reinforce symptom cycles even in the absence of true food intolerance. Therefore, intervening at the level of food-related fear, rather than merely targeting food content, may be crucial in breaking this vicious cycle. Longitudinal and interventional studies are warranted to explore this interplay and test whether integrating psychological support into dietary counseling improves the outcomes in IBS and FD.

This study had several strengths. The food triggers, the fear of food, and their impact on HRQoL in IBS and FD patients were compared with HCs. Unlike previous studies focusing on broad dietary patterns, this study examined individual food items rather than prepared meals, ensuring greater specificity in assessing dietary triggers. This approach is particularly relevant in a culturally diverse country like India, where food preparation and cuisine vary significantly. Furthermore, including the FFQ-18 scores provides novel insights into the psychological burden of dietary choices, emphasizing the role of food-related fears in shaping dietary behaviors. In addition, this study used a rigorous definition of food triggers, reducing recall bias and enhancing reproducibility.

Nevertheless, this study had some limitations. First, being a cross-sectional and recall-based study, the exact contribution of food-related fears in causing dietary restrictions cannot be inferred. Second, micronutrient intake (e.g., iron, calcium, and B vitamins) was not evaluated, which could have provided additional insights into the nutritional consequences of dietary restriction. Third, hydrogen breath testing was not performed, preventing direct confirmation of lactose and fructose malabsorption and their effects on symptoms. Finally, the exclusion of patients already on GFD or LFD or those with significant weight loss might have inadvertently led to the omission of individuals with severe food-related anxiety or avoidant/restrictive food intake disorder. Although this was methodologically necessary to prevent confounding in dietary analysis, it may have resulted in the under-representation of individuals with more severe food-related anxiety or those at the highest risk of malnutrition, limiting generalizability to the

broader DGBI population. Future studies should assess these patients separately to understand their dietary behaviors. Despite these limitations, this study lays a strong foundation for longitudinal studies to assess the nutritional and psychological impact of food avoidance and food fears from a pathophysiological aspect and as a potential therapeutic option.

In conclusion, food triggers are more commonly reported in IBS and FD patients than in HCs, leading to substantial dietary restrictions. The FODMAP and macronutrient intake were significantly lower in the IBS and FD patients, particularly in those with severe symptoms. Importantly, food-related fears are strongly correlated with dietary restrictions and HRQoL impairment. These findings highlight the need for a paradigm shift from elimination-based dietary counseling to a more balanced, patient-centered approach. Rather than enforcing restrictive diets, clinicians should prioritize identifying food-related fear, addressing psychological distress, and integrating behavioral interventions into dietary counseling. Personalized guidance led by trained dietitians and gastroenterologists, focusing on the structured reintroduction of foods and cognitive interventions, is critical for preventing long-term malnutrition and improving the quality of life in IBS and FD patients. Future studies should evaluate interventions targeting food-related fears and their impact on symptom control and HRQoL to refine dietary management strategies for DGBIs.

ETHICAL STATEMENT

Prospective approval for this study was taken from Institutional Ethics committee vide no. DMCTVR&D/2021/8, on 20th January 2021. Informed consent in vernacular was taken from all study participants.

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SUPPLEMENTARY MATERIAL

Supplementary material is available at the Korean Journal of Gastroenterology website (https://www.kjg.or.kr/).

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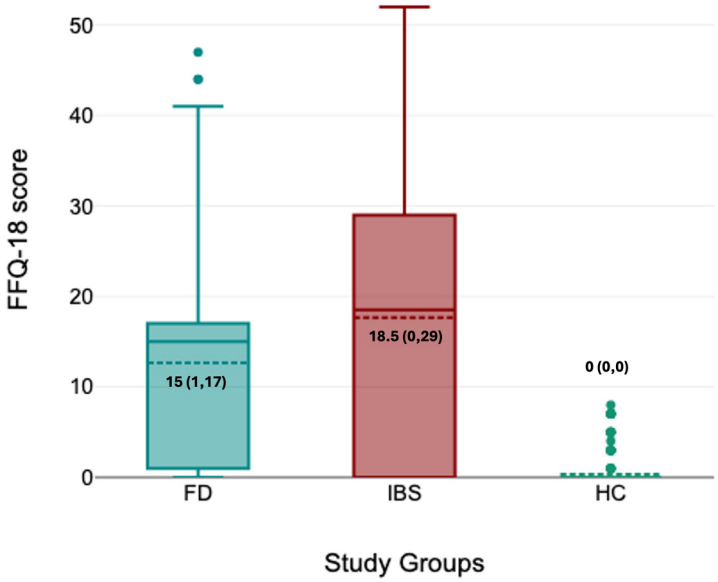
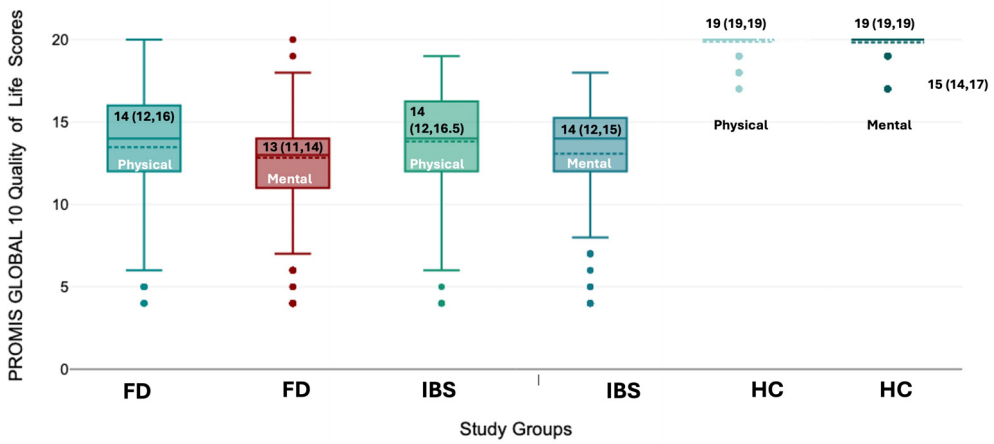
Supplementary Table 1. Clinical, Psychological, and Dietary Characteristics of IBS Patients Stratified by Symptom Severity (Mild, Moderate, and Severe), as Assessed by the IBS-SSS

Variable	Mild (n-59)	Moderate (n-42)	Severe (n-59)	p-value
Age	40.8±11.3	42.6±13.2	40.7±10.7	0.675‡
Sex (male:female)	42:17	24:18	32:27	0.137014*
FFQ-18 score	2 (0, 7.5)	15.5 (0, 22)	33 (27.5, 38.5)	<0.00001†
Physical QoL score	14.9±2.1	13.5±2.5	10.4±2.1	<0.00001†
Mental QoL score	14.4±2.0	13.1±2.4	10.1±2.5	<0.00001†
Food-Triggers	14 (23.7)	26 (61.9)	48 (81.4)	<0.00001*
1	10 (16.9)	12 (28.6)	21 (35.6)	0.001524*
2	3 (5.1)	11 (26.2)	16 (27.2)	
>2	1 (1.7)	3 (7.1)	11 (18.6)	

Data are expressed as mean±standard deviation or number (percent) or median (interquartile range), as appropriate.
ANOVA, analysis of variance; FFQ-18, fear of food questionnaire-18; IBS, irritable bowel syndrome; IBS-SSS, IBS symptom severity score; QoL, quality of life; PROMIS, patient-reported outcomes measurement information system.
Mild 75 to175, Moderate 176 to 300, Severe >300 as per IBS-SSS.
*Chi-Square test; †ANOVA test; ‡unpaired t test.



Supplementary Fig. 1. Box and whisker plot comparing the Fear of Food Questionnaire-18 (FFQ 18) scores between patients with functional dyspepsia (FD), irritable bowel syndrome (IBS), and healthy controls (HC). The data are represented as the median (inter-quartile range).



Supplementary Fig. 2. Box and whisker plot comparing PROMIS Global Physical and Mental Quality of Life (QoL) scores between patients with functional dyspepsia (FD), irritable bowel syndrome (IBS), and healthy controls (HC). The data are represented as the median (inter-quartile range).

Supplementary Material 1.

Fear of Food Questionnaire
Please rate the degree to which you believe each of the following statements:

Item	Not at All	A Little	Somewhat	Moderately	Quite a Bit	Absolutely
1. I try hard to identify foods that trigger GI symptoms	0	1	2	3	4	5
2. I cannot tolerate certain foods.	0	1	2	3	4	5
3. I try to avoid eating trigger foods.	0	1	2	3	4	5
4. The range of foods it feels "safe" to eat has grown pretty narrow.	0	1	2	3	4	5
5. Sometimes I don't eat in order to avoid dealing with GI symptoms.	0	1	2	3	4	5
6. If I could survive without eating, it would be a huge relief.	0	1	2	3	4	5
7. I'm afraid of experiencing GI symptoms when I eat.	0	1	2	3	4	5
8. I'm afraid to eat certain foods.	0	1	2	3	4	5
9. Food sometimes feels like the enemy.	0	1	2	3	4	5
10. If a certain food triggers GI symptoms, I worry about eating it again.	0	1	2	3	4	5
11. I have lost too much weight because I avoid eating.	0	1	2	3	4	5
12. My restricted diet makes it harder to go out and socialize.	0	1	2	3	4	5
13. People in my life don't always support my efforts to eliminate trigger foods from my diet.	0	1	2	3	4	5
14. My restricted diet sometimes causes conflict with people in my life.	0	1	2	3	4	5
15. I can't enjoy food the way I used to.	0	1	2	3	4	5
16. I have had to give up foods that I enjoy.	0	1	2	3	4	5
17. I really miss eating certain foods.	0	1	2	3	4	5
18. My restrictive diet frustrates me.	0	1	2	3	4	5

To score the FFQ just add up the numbers you circled My Score_____

None: 0-15
Mild: 16-30
Moderate: 31-45
Severe: 46-90

Supplementary Material 2.

PROMIS Global--10 Score

Patient Name: _____

Date: _____

Please respond to each question or statement by marking on box per row.

	Excellent	Very Good	Good	Fair	Poor
1. In general, would you say your health is:	☐+5	☐+4	☐+3	☐+2	☐+1
2. In general, would you say your quality of life is:	☐+5	☐+4	☐+3	☐+2	☐+1
3. In general, how would you rate your physical health?	☐+5	☐+4	☐+3	☐+2	☐+1
4. In general, how would you rate your mental health, including your mood and your ability to think?	☐+5	☐+4	☐+3	☐+2	☐+1
5. In general, how would you rate your satisfaction with your social activities and relationships?	☐+5	☐+4	☐+3	☐+2	☐+1
9r. In general, please rate how well you carry out your usual social activities and roles. (This includes activities at home, at work and in your community, and responsibilities as a parent, child, spouse, employee, friend, etc.)	☐+5	☐+4	☐+3	☐+2	☐+1

	Completely	Mostly	Moderately	A little	Not at all
6. To what extent are you able to carry out your everyday physical activities such as walking, climbing stairs, carrying groceries, or moving a chair?	☐+5	☐+4	☐+3	☐+2	☐+1

	Never	Rarely	Sometimes	Often	Always
10r. How often have you been bothered by emotional problems such as feeling anxious, depressed or irritable?	☐+5	☐+4	☐+3	☐+2	☐+1

	None	Mild	Moderate	Severe	Very Severe
8r. How would you rate your fatigue on average?	☐+5	☐+4	☐+3	☐+2	☐+1

	No pain										Worst pain imaginable
7rc. How would you rate your pain on average?	☐+0	☐+1	☐+2	☐+3	☐+4	☐+5	☐+6	☐+7	☐+8	☐+9	☐+10

Global Physical Health raw score:

1. Recalculate Question 7r

"0: No pain": +5 "1", "2" or "3": +4 "4", "5" or "6": +3

"7", "8" or "9": +2 "10: Worst pain imaginable: +1

Q7rc recorded score: ____ Q7rc recalculated score: ____

2. Sum the responses for questions Q3, Q6, Q7r (recalculated), and Q8r

Q3: ____ + Q6: ____ + Q7r: ____ + Q8r: ____ = ____ points

Global Mental Health raw score:

1. Sum the responses for questions Q3, Q6, Q7r (recalculated), and Q8r

Q2: ____ + Q4: ____ + Q5: ____ + 10r: ____ = ____ points

Global Physical Health T--score and Global Mental Health T--score:

1. Use the below raw sum to T---score tables for physical health and mental health.

Global Physical Health T---score: ____ points

Global Mental Health T---score: ____ points

PROMIS Global Physical Health v1.2		
Short Form Conversion Table		
Raw Summed Score	T---Score	SE*
4	16.2	4.8
5	19.9	4.7
6	23.5	4.5
7	26.7	4.3
8	29.6	4.2
9	32.4	4.2
10	34.9	4.1
11	37.4	4.1
12	39.8	4.1
13	42.3	4.2
14	44.9	4.3
15	47.7	4.4
16	50.8	4.6
17	54.1	4.7
18	57.7	4.9
19	61.9	5.2
20	67.7	5.9
*SE = Standard Error on T---score metric		

PROMIS Global Mental Health v1.2		
Short Form Conversion Table		
Raw Summed Score	T---Score	SE*
4	21.2	4.6
5	25.1	4.1
6	28.4	3.9
7	31.3	3.7
8	33.8	3.7
9	36.3	3.7
10	38.8	3.6
11	41.1	3.6
12	43.5	3.6
13	45.8	3.6
14	48.3	3.7
15	50.8	3.7
16	53.3	3.7
17	56.0	3.8
18	59.0	3.9
19	62.5	4.2
20	67.6	5.3
*SE = Standard Error on T---score metric		