RESEARCH
Original Research

Subtypes and Severity of Irritable Bowel Syndrome Are Not Related to Patients' Self-Reported Dietary Triggers: Results From an Online Survey in Dutch Adults

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ABSTRACT

Background Diet plays an important role in symptom management of irritable bowel syndrome (IBS). However, current diet therapies are not optimal nor successful for everyone.

Objective To investigate whether subgroups based on IBS subtypes or severity identify different self-reported dietary triggers, and whether these are associated with severity and psychological factors.

Design Online cross-sectional survey

Participants Patients with IBS (n = 1601) who fulfilled the Rome IV criteria or had an IBS diagnosis.

Main outcomes Self-reported response to 44 preselected dietary triggers, IBS quality of life, and anxiety and depression. Subgroups were based on subtypes or severity.

Statistical analysis Response to dietary triggers was analyzed using multiple correspondence analysis. Moreover, a food score was calculated to quantify the number and severity of responses to dietary triggers.

Results Response to greasy foods, onions, cabbage, and spicy and fried foods were mentioned most often (ranging between 55% and 65%). Response to dietary triggers differed between subtypes and severity groups, but absolute differences were small. Multiple correspondence analysis did not reveal clustering between dietary triggers, and ellipses for the subtypes overlapped. Some clustering was seen when ellipses were drawn for severity, which indicates that severity explained a fraction of the variation in response to dietary triggers, and subtypes did not. The food score was not significantly different between subtypes but was significantly higher with higher levels of severity (mild = 20.9 ± 17, moderate = 29.2 ± 19, severe = 37.9 ± 20, $P < .001$), having depressive (no = 31.4 ± 20, yes = 37.4 ± 20, $P < .001$) or anxious symptoms (no = 30.7 ± 20, yes = 35.2 ± 20, $P < .001$), and lower quality of life (lower quality of life = 38.5 ± 19, higher quality of life = 26.5 ± 19, $P < .001$).

Conclusion Patients with different IBS subtypes or IBS severity do not identify different self-reported dietary triggers. Patients with more severe IBS and who experience anxiety or depression tend to have severe responses to more dietary triggers. IBS severity seems a better classifier than Rome IV criteria regarding diet. Dietary treatment needs to be individualized under guidance of a dietitian.

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IRRITABLE BOWEL SYNDROME (IBS) IS A FUNCTIONAL gastrointestinal disorder, which is characterized by abdominal pain and abnormal defecation patterns, and global prevalence is estimated between 10% and 20%.[1-6] The pathophysiology is unknown but is suggested to include altered intestinal permeability, gastrointestinal motility, gut microbiota composition, low-grade inflammation, and visceral hypersensitivity.[7-10] IBS is diagnosed using the Rome IV criteria and can be divided into subtypes: constipation-predominant IBS (IBS-C), diarrhea-predominant IBS (IBS-D), IBS with a mix of constipation and diarrhea (IBS-M), or IBS with no specific stool pattern, so-called unclassified IBS (IBS-U).[11] Moreover, based on a validated questionnaire that assesses complaints and its impact

on daily life, patients can be also classified as having mild, moderate, or severe IBS.[12]

Although IBS does not harm the intestines nor is a life-threatening disorder, it strongly affects quality of life and impairs daily functioning.[2] Moreover, patients with IBS frequently present comorbidities, such as depression, anxiety or chronic fatigue.[13-16] Guidelines for treatment of IBS include medication, psychological interventions or dietary adjustments.[17] Diet is a known trigger of symptoms: in a survey that included 135 patients with IBS, nearly 90% of patients with IBS reported having gastrointestinal complaints induced by specific foods.[18] Foods reported to cause symptoms were spicy and fatty foods, vegetables, and cereal-based foods.[18] The majority of patients with IBS reported to have adjusted their diet to reduce symptoms, but only 12% did this under supervision of a dietitian.[18] The most frequently advised diet focusses on exclusion of foods high in fermentable oligosaccharides, disaccharides, monosaccharides and polyols (FODMAP diet). Although effective for some patients with IBS, the complexity of the FODMAP diet limits its use and compliance.[19-21] Moreover, excluding foods from different food groups may lead to nutritional deficiencies.

Currently, it is unclear why certain patients benefit from diet therapies, whereas others do not. Possibly, the large heterogeneity of the population and the multifaceted pathophysiology of IBS affect the response. Indeed, Simrén et al showed that patients with anxiety with IBS responded to more foods with severe complaints than patients with anxiety. No difference in response to foods was found between the IBS subtypes.[22] However, Böhn et al did not find any difference between patients with and patients without anxiety with IBS in regards to food allergens.[23] It is questionable whether these studies were large enough to capture all facets of self-perceived food intolerance of the heterogenous IBS population and assess differences between subgroups such as the IBS subtypes.

Thus, more insight is needed to understand the interplay between dietary triggers, IBS characteristics, and depression or anxiety. Therefore, we investigated whether subgroups based on IBS subtypes and IBS severity identify different dietary triggers. Additionally, we investigated whether the number of dietary triggers to which a patient responds and severity of complaints linked to dietary triggers are associated with IBS quality of life and depression or anxiety.

RESEARCH SNAPSHOT

Research Question: Do subgroups based on IBS subtypes or severity identify different self-reported dietary triggers, and are these are associated with IBS severity and psychological factors?

Key Findings: In this cross-sectional nationwide survey that included 1601 patients with IBS, patients of different IBS subtypes or severity class did not identify different dietary triggers. Patients with more severe IBS and who experience anxiety or depression tend to have severe responses to more dietary triggers. Treatment plans need to be individualized, with an important role for dietitians and other care givers.

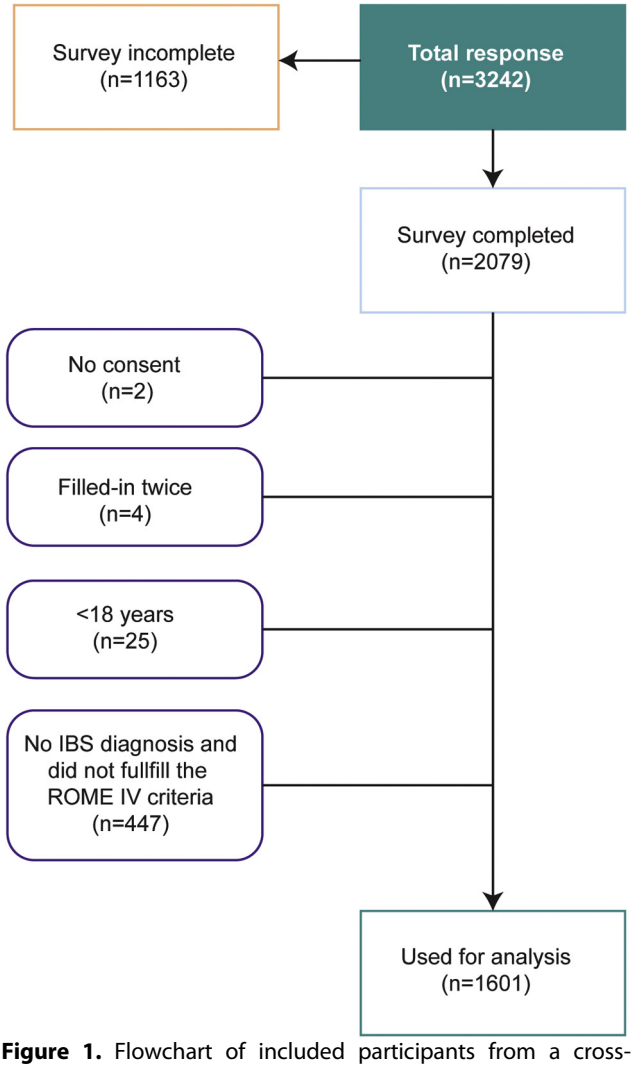

Figure 1. Flowchart of included participants from a cross-sectional online survey in Dutch IBS patients. IBS; Irritable Bowel Syndrome. Duplicate responses were checked by duplicate e-mail address in combination with city of residence. When duplicate responses were found, only the most recently filled in response was included. Incomplete responses were often within the first few questions; probably due to total completion time (estimated between 30 and 60 minutes)

MATERIALS AND METHODS

We performed a nationwide cross-sectional online survey in the Netherlands from January until May 2018. Participants were recruited via several platforms, including a national newspaper, the Dutch IBS patient association, social media, and recruitment websites of Wageningen University & Research. Because recruitment was online and open, no response rate could be calculated. All information collected was self-reported. Figure 1 shows the flowchart of the included participants (complete questionnaire, consent, >18

years, and IBS diagnosis or fulfillment of the ROME IV criteria). If participants had filled in the questionnaire twice, only the most recent one was used (n = 4); this was checked using e-mail address of the participant and city of residence.

The survey was performed using the platform LimeSurvey[24] and was developed and monitored by the research team. The questionnaire was pretested by several colleagues and patients with IBS from the Dutch IBS patient association, who provided feedback on clarity and completion time, which was estimated around 45 to 60 minutes. Participants had to complete a CAPTCHA code for loading and saving the survey. Among the participants, 25 vouchers of €10 and 10 vouchers of €25 for (web) shops were raffled as incentive, using Excel[25] formulas for generating random number. If this number matched the participant survey identification, the participant was contacted for the incentive. Survey data were downloaded from Limesurvey sever into Excel and SPSS files, which was protected by the most common secure socket layer method (encryption) and was in fulfillment of the European Privacy Law. Participants consented to sharing their data with the researchers before filling in the survey. The medical ethical committee of Wageningen decided that no formal ethical approval was needed, due to the low burden and risk of the study. This study was registered at Clinicaltrials.gov, under number NCT03824821.

IBS Characteristics

An overview of the validity and reliability of questionnaires assessed in the survey can be found in Figure 2. Patients were classified into subtypes IBS-C, IBS-D, IBS alternating between constipation and diarrhea, or unclassified IBS, based on their most frequent self-reported stool types,[26] by ranking their stool types over the last 4 weeks from most frequent to least frequent using the Bristol stool chart.[1] The 3 most frequently reported stool types were used to decide to which subgroup patients belonged. The validated 14-item Birmingham questionnaire was used to validate IBS subtype grouping.[27] Symptom severity was assessed using the validated IBS-Symptom Severity Score (IBS-SSS).[12,28] Based on this score, patients with IBS were classified for their severity into mild ($\leq$175), moderate (175-300), or severe ($\geq$300) IBS.[12]

Psychological Assessment

Patients completed the validated 34-item Irritable Bowel Syndrome Quality of Life (IBS-QoL) questionnaire to compute a score for overall IBS-QoL.[29,30] Participants also completed the validated screening Hospital Anxiety and Depression score.[31] A score $\geq$8 was indicative for having anxious or depressive symptoms.[32]

Dietary Triggers

Foods known for initiating IBS symptoms ("dietary triggers") were identified based on previous research[18,22] and were split up into 8 food categories and 36 food products, as shown in Figure 3A and 3B. Participants scored all 44 dietary triggers on a 3-point Likert scale (0 = no complaints; 1 = little complaints; 2 = severe complaints; I don't know, I don't use this). From these data, similar to Simrén et al,[22] we calculated an overall food score by summing the 44 items and multiplying by the Likert scale score. Because some patients respond severely to few dietary triggers or have some complaints to many dietary triggers, the food score enabled us to quantify the response for each patient and summarize this in one score. Moreover, we used the food score to test for associations between dietary triggers and IBS-QoL, IBS-SSS, and anxiety and depression. To prevent underestimation of the score, answer options "I don't know" or "I don't use this" were handled as missing instead of 0 when computing the food score. By standardizing the food score to a scale of 0 to 100, by taking into account their personal maximum (=44 minus the number of missing answers multiplied by 2), the sum scores were corrected to prevent that patients with higher scores on fewer items received the same score as patients with lower scores for more items. The formula for the food score is as follows:

$$\frac{(\#\text{products mild complaints} \times 1) + (\#\text{products severe complaints} \times 2)}{\text{personal maximum} : (44 - \#\text{ missings}) \times 2} \times 100$$

For example, if a participant answered "I don't know" to 10 out of 44 food products, their maximal possible food score was 68 points (34 items, maximum score of 2 points per food). Therefore, their summed score was divided by 68 and multiplied by 100. A score of 100 indicates that a participant responds to all products severely, and 0 indicates that a participant experienced no complaints to any of the triggers.

Statistical Analysis

Data are presented as mean $\pm$ standard deviation for continuous data or median (interquartile range) when data are skewed. For categorical data, counts and percentages are given. To test for differences between groups, analysis of variance and Bonferroni post hoc testing and correction,[33] Kruskall-Wallis testing when not normally distributed, or a χ^2 test for categorical data was used. Data were stratified for IBS subtypes and severity groups. Moreover, food score results were stratified for age (median split), sex, anxious or depressive symptoms (based on Hospital Anxiety and Depression cutoffs), and IBS-QoL scores (median split) to assess possible differences.

Food score data were analyzed using multiple linear regression to assess associations in separate models between food score (independent variable) and IBS-QoL, IBS-SSS, and anxiety and depression (dependent variables). Regression analysis was corrected for age, sex, and body mass index in model 1, and in model 2 anxiety and depression were added. Moreover, crude dietary trigger data were analyzed using multiple correspondence analysis (MCA) to assess if there were certain patterns within the dietary trigger responses. MCA can be seen as a qualitative version of principal component analysis and allows us to analyze patterns of several categorical variables per subject.[34] Answer options "I don't know" or "I don't use this" were included in the MCA analysis to obtain a complete overview. Ellipses for IBS

First author (year)	Questionnaire	Method	Validity measures	Additional research
Roalfe (2008)[25]	Birmingham Questionnaire: 14 items on a 6-point Likert scale. Gives a score for pain, diarrhea, and constipation of the last 4 wk.	Retest 1 week later, based on Rome II questionnaire. Compared with IBS-QoL[b].	**Pain:** Cronbach $\alpha = .74$, validity $r = -0.4$ to -0.6, reproducibility ICC[c] $= 0.75$. **Constipation:** Cronbach $\alpha = .79$, validity $r = -0.1$ to -0.3, reproducibility ICC $= 0.78$. **Diarrhea:** Cronbach $\alpha = .90$, validity $r = -0.3$ to -0.5, reproducibility ICC $= 0.81$. **Overall:** Cronbach $\alpha = .75$, validity $r = -0.5$ to -0.7, reproducibility ICC $= 0.78$.	
Blake (2016)[24]	Bristol stool chart has 7 types of different stool with pictures.	Comparison with stool water, classification by experts, and comparison between IBS-D[c] and healthy and duplicate stools.	Correlation with stool water $r = 0.49$. Differences between healthy patients and patients with IBS-D was found ($P < .0001$). Overall, 977/1204 (81%) of the stools were correctly classified: substantial accuracy $= 0.78$. Sustainable reliability was 76%, but lower reliability for type 2 (63%) and type 3 (62%).	
Zigmond (1983)[29]	HADS[d]; 11 items on a 5-point Likert scale. Ranges from 0 to 21. A score ≥ 8 indicates having anxious or depressive symptoms.	Compared with psychological interviews	**Anxiety:** internal consistency between each item and total score $= 0.41$ to 0.76, correlation with interview $r = 0.74$, 5% false-positive, 1% false-negative. **Depression:** internal consistency between each item and total score $= 0.30$ to 0.60. Correlation with interview $r = 0.70$. 1% false-positive, 1% false-negative.	Literature review by Bjeland et al compared 19 studies that investigated validity of the HADS. They conclude that the HADS performs well as a screening questionnaire for separate dimensions of anxiety and depression.[30]

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Figure 2. Validity of the questionnaires used in a cross-sectional online survey in 1601 Dutch patients IBS.[a]

First author (year)	Questionnaire	Method	Validity measures	Additional research
Patrick (1998)[27]	IBS-QoL, 34 items on a 5-point Likert scale. The score ranges from 0 to 100; 100 indicating good QoL[e].	Retest 1 wk later, compared with SF-36[f], PWGB[g], SCL90-R[h]	**Overall:** Cronbach $\alpha = .95$, internal reliability = 0.95, reproducibility ICC = 0.86. **Subscales:** Cronbach $\alpha = .74$-.92, reproducibility ICC = 0.65-0.89.	Andrea et al reproduced the original article, but with a special focus on patients with IBS-D. Was compared with HRQOL[i]. The questionnaire demonstrated very good construct validity.[28]
Francis (1997)[12]	IBS-SSS[j]. Includes 5 items regarding pain (intensity and number of days), abdominal distention, satisfaction of bowel habit, and interference of daily life of the last 10 d on a 10-point scale. Gives a score between 0 and 500, and groups of severity can be made: mild ($\leq$175), moderate (175-300), and severe ($\geq$300) IBS.	Three different groups of IBS patients, comparison with clinical rating by gastroenterologists, retest 1 d later.	Good reproducibility (Δ6 range: −107;75 on a score from 0 to 500). Able to pick up improvements after treatment.	Literature review by Mujagic et al concludes that IBS-SSS includes the largest number of questions related to pain and "appears to be the best retrospective instrument that can be used for the assessment of broader GI-symptom severity in IBS, including abdominal pain." [26]

[d]IBS-D = diarrhea-predominant IBS.
[a]IBS = irritable bowel syndrome.
[b]IBS-QoL = IBS Quality of Life questionnaire.
[c]ICC = Intra-class correlation Coefficient
[d]HADS = Hospital Anxiety and Depression Score
[e]QoL = quality of life.
[f]SF36 = Medical Outcome Study Short Form 36
[g]PWGB = Psychological General Well-Being Scale
[h]SCL90-R = Symptom Check List
[i]HRQOL = Health-related Quality of Life
[j]IBS-SSS = IBS Symptom Severity Score.

Figure 2. *(continued)* Validity of the questionnaires used in a cross-sectional online survey in 1601 Dutch patients IBS.[a]

subtype and IBS severity groups were drawn based on a 95% confidence interval. Statistical analyses were performed using SPSS[35] and R,[36] and a P value $< .05$ was considered significant.

RESULTS

Participant Characteristics

This study included 1601 participants, with a median age of 47 (29-60) years and 291 (18%) were male. Patient characteristics, stratified for IBS subtype or IBS severity, are shown in Table 1. IBS subtype classification was in accordance with the Birmingham diarrhea and constipation score, which was high or low accordingly with the subtype and significantly different between IBS subtypes ($P < .001$). Age, sex, body weight, body mass index, IBS-SSS, and IBS-QoL differed significantly between the IBS subtypes. Among the IBS subtypes, a comparable percentage of patients with anxious or depressive symptoms were seen. In contrast, between the 3 IBS severity groups, IBS-QoL and anxiety and depression scores were significantly different ($P < .001$). Of the total population, only 584 (36%) was currently using medication, predominantly by patients with severe IBS. Antibiotics was the least used medication (n = 50, 3%), and fiber supplementation was the most used (n = 469, 29%). Significant differences between IBS subtypes were found for medications related to subtype complaints (ie, patients with IBS-D significantly used more antidiarrheal medications [$P < .000$] and patients with IBS-C used significantly more laxatives [$P < .000$]).

Of the 1601 participants, 1143 (71%) indicated that they changed their diet due to abdominal complaints, of which 480 (30%) participants reported doing this under supervision of a dietitian. Of this subgroup, 59% reported improvements in complaints after guidance by a dietitian. Either currently or in the past, 460 (29%) participants reported following the FODMAP diet, which was not significantly different between the IBS subtypes ($P = .938$) but again was different between the severity groups, with a significantly higher percentage of patients with severe IBS following the FODMAP diet (mild 20%, moderate 23%, severe 36%, $P < .001$). After following the FODMAP diet, 238 (52%) participants reported improvements in complaints.

Self-Reported Dietary Trigger Differences Between IBS Subtypes and Severity Groups

Figure 3A and 3B provide an overview of the prevalence of experiences with dietary triggers for the whole IBS population. The prevalence of "I don't know" answers ranged between 13% and 34%, and the prevalence of "I don't use this"

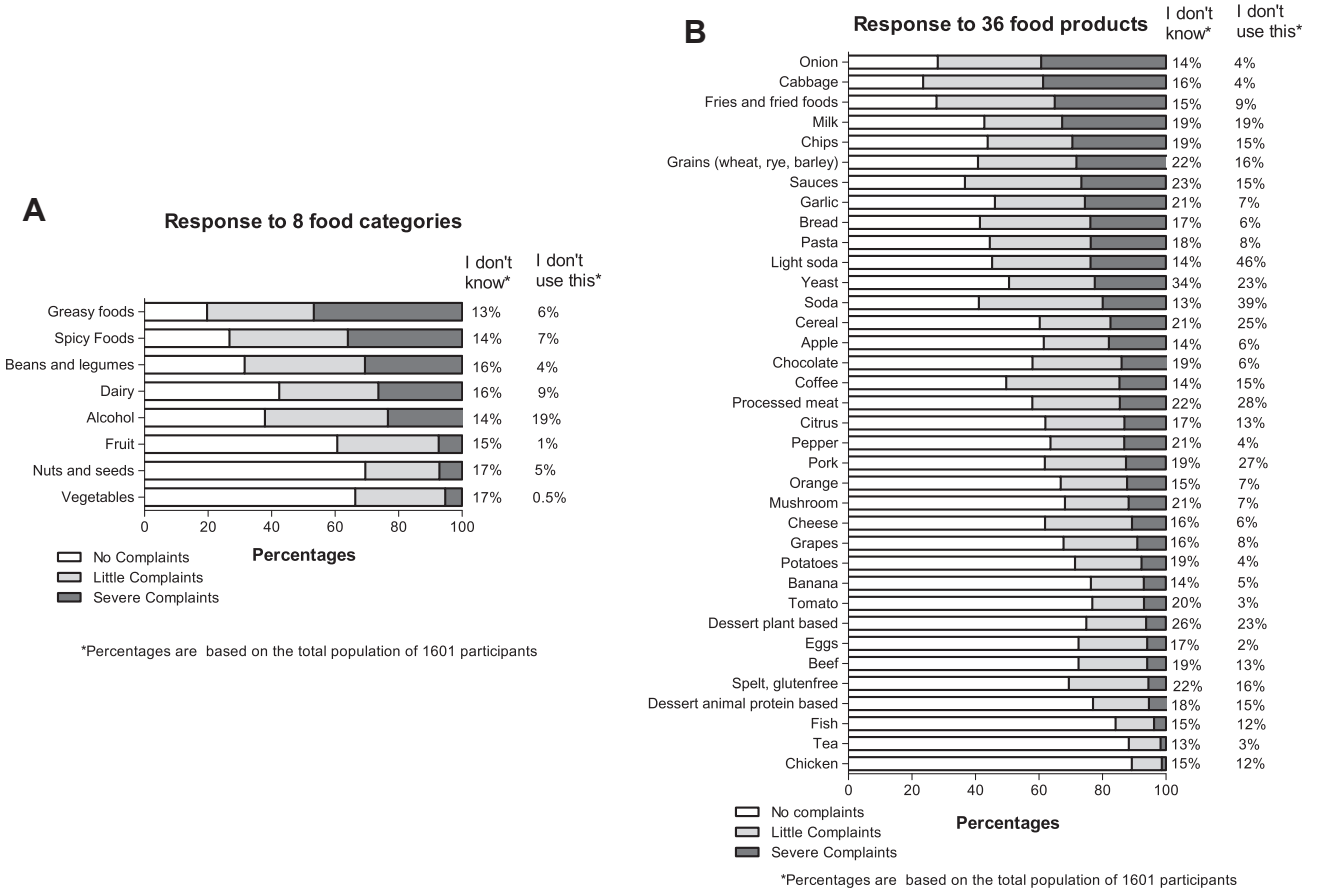

Figure 3. Self-reported response to dietary triggers of 8 food categories and 36 food products from a cross-sectional online survey in 1601 Dutch IBS patients. Legend: patients indicated their response on a 3-point Likert scale "no complaints", "little complaints" or "severe complaints". Food categories and products are predefined using literature based on previously reported dietary triggers. Percentages given are excluded participants who indicated "I don't know" or "I don't use this". IBS; Irritable Bowel Syndrome.

Table 1. Participant characteristics, stratified by IBS[a] subtype or IBS severity, based on the results of a cross-sectional online Dutch survey in 1601 patients with IBS[b]

	IBS Subtypes					IBS Severity Groups			
Characteristic	**IBS-C[c] (n = 545)**	**IBS-D[d] (n = 557)**	**IBS-M[e] (n= 420)**	**IBS-U[f] (n = 79)**	***P* value[g]**	**Mild IBS (n = 174)**	**Moderate IBS (n= 661)**	**Severe IBS (n = 766)**	***P* value**
	median (interquartile range)								
Age (y)	47 (28-59)[wx]	48 (31-61)[w]	47 (29-60)[wx]	40 (24-57)[x]	**.040**	53 (32-64)[w]	48 (29-62)[w]	44 (28-58)[x]	**.000**
	n (%)								
Male sex	82 (15)	123 (22)	66 (16)	20 (25)	**.003**	48 (28)	135 (20)	108 (14)	**.000**
	mean ± SD[h]								
BMI[i], self-reported[j]	23.2 ± 3.9[w]	24.5 ± 4.4[x]	24.1 ± 4.1[x]	22.7 ± 3.4[w]	**.000**	23.5 ± 3.4[w]	23.7 ± 3.8[w]	24.2 ± 4.5[w]	**.049**
	n (%)								
Current smokers	35 (6)	46 (8)	36 (9)	6 (8)	.583	8 (5)	35 (5)	80 (10)	**.000**
Educational level					.067				**.002**
High school or vocational secondary education	126 (23)	143 (26)	135 (32)	16 (20)		40 (23)	154 (23)	228 (30)	
Higher or academic education	419 (77)	414 (74)	283 (68)	63 (80)		134 (77)	507 (77)	538 (70)	
	mean ± SD								
IBS-SSS[k]	275 ± 85[w]	288 ± 81[wx]	293 ± 88[x]	300 ± 79[wx]	**.004**				
	n (%)								
IBS-SSS groups					**.013**	N/A	N/A	N/A	
Mild (≤175)	71 (13)	49 (9)	51 (12)	3 (4)					
Moderate (175-300)	234 (43)	242 (43)	152 (36)	33 (42)					
Severe (≥300)	240 (44)	266 (48)	217 (52)	43 (54)					
IBS subtypes	N/A	N/A	N/A	N/A					
IBS-C						71 (41)	234 (35)	240 (31)	**.013**
IBS-D						49 (28)	242 (37)	266 (35)	
IBS-M						51 (29)	152 (23)	217 (28)	
IBS-U						3 (2)	33 (5)	43 (6)	
	mean ± SD								
Birmingham score									
Constipation	51.2 ± 25[w]	21.2 ± 19[x]	43.3 ± 24[y]	32.6 ± 18[z]	**.000**	29.8 ± 24[w]	36.2 ± 25[x]	41.0 ± 27[y]	**.000**
Diarrhea	13.5 ± 11[w]	33.0 ± 18[x]	26.3 ± 15[y]	17.6 ± 14[w]	**.000**	16.6 ± 13[w]	20.7 ± 15[x]	28.2 ± 19[y]	**.000**

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Table 1. Participant characteristics, stratified by IBS[a] subtype or IBS severity, based on the results of a cross-sectional online Dutch survey in 1601 patients with IBS[b] (*continued*)

	IBS Subtypes					IBS Severity Groups			
Characteristic	**IBS-C[c] (n = 545)**	**IBS-D[d] (n = 557)**	**IBS-M[e] (n= 420)**	**IBS-U[f] (n = 79)**	***P* value[g]**	**Mild IBS (n = 174)**	**Moderate IBS (n= 661)**	**Severe IBS (n = 766)**	***P* value**
Pain	45.8 ± 19[w]	48.7 ± 19[w,x]	49.2 ± 19[x]	47.8 ± 17[wx]	**.021**	24.7 ± 12[w]	41 ± 14[x]	58.8 ± 16[y]	**.000**
IBS-QoL[l]	75.5 ± 18[w]	70.7 ± 20[x]	71.1 ± 20[x]	73.9 ± 20[wx]	**.000**	87.9 ± 9[w]	79.1 ± 14[x]	63.5 ± 20[y]	**.000**
	median (interquartile range)								
Anxiety score	6 (4-10)	6 (4-10)	6 (4-9)	6 (4-10)	.636	4 (3-7)[w]	6 (4-9)[x]	7 (5-11)[y]	**.000**
	n (%)								
Having anxious symptoms	214 (39)	228 (41)	159 (38)	33 (42)	.770	37 (21)	228 (34)	369 (48)	**.000**
Depression score median (IQR)	3 (1-6)	3 (1-6)	3 (1-7)	3 (1-6)	.198	1 (0-3)[w]	3 (1-5)[x]	4 (2-8)[y]	**.000**
Having depressive symptoms n (%)	88 (16)	102 (18)	84 (20)	8 (10)	.127	8 (5)	79 (12)	195 (25)	**.000**

Note: Bold values indicate statistical significance ($P < .05$).

[a]IBS = irritable bowel syndrome.

[b]Self-reported data are obtained using validated questionnaires such as the IBS-SSS,[12] IBS-QoL (range 0-100; 100 indicates good QoL),[27] Birmingham questionnaire,[25] Hospital Anxiety and Depression score (range from 0-21, score ≥8 indicates substantial anxious or depressive symptoms),[29,30] and the Bristol stool chart, which was used to compute the IBS subtypes,[24] based on the three most frequent habitual stool types.

[c]IBSC-C = IBS with predominantly constipation.

[d]IBS-D = IBS with predominantly diarrhea.

[e]IBS-M = IBS alternating between diarrhea and constipation.

[f]IBS-U = IBS unspecified.

[g]*P* values indicate differences between the different IBS subtype or severity groups and are tested using an analysis of variance and Bonferroni post hoc testing, Kruskal Wallis when skewed, or χ^2 for categorical data.

[h]BMI = body mass index.

[i]SD = standard deviation.

[j]Missing n = 6.

[k]IBS-SSS = Irritable Bowel Syndrome Symptom severity score.

[l]IBS-QoL = Irritable Bowel Syndrome Quality of Life questionnaire.

[wxyz]Different superscripts indicate significance between the subgroups.

Table 4. Food score stratified for IBS[a] subtypes, IBS severity, age, sex, depression, anxiety and IBS-QoL[b] scores, and multiple linear regression between the food score and IBS severity, IBS quality of life, anxiety and depression, based on a cross-sectional online Dutch survey in 1601 patients with IBS[c]

Food score stratified		*P* value[d]
IBS subtypes	*mean ± SD*[e]	
IBS-C[f] (n = 518)	30.9 ± 19	.073
IBS-D[g] (n = 531)	33.8 ± 20	
IBS-M[h] (n = 403)	33.1 ± 20	
IBS-U[i] (n = 75)	30.0 ± 22	
IBS-SSS[jk]		
Mild (n = 166)	20.9 ± 17[y]	**.000**
Moderate (n = 629)	29.2 ± 19[z]	
Severe (n = 732)	37.9 ± 20[c]	
Age[l]		
<47 years (n = 774)	33.3 ± 19	.095
≥47 years (n = 753)	31.6 ± 21	
Sex		
Male (n = 263)	28.3 ± 21	**.000**
Female (n = 1264)	33.4 ± 20	
Having depressive symptoms[m]		
No (n = 1258)	31.4 ± 20	**.000**
Yes (n = 269)	37.4 ± 20	
Having anxious symptoms[m]		
No (n = 921)	30.7 ± 20	**.000**
Yes (n = 606)	35.2 ± 20	
IBS-QoL[l]		
<77.9 (n = 760)	38.5 ± 19	**.000**
>77.9 (n = 767)	26.5 ± 19	
Multiple linear regression	*ß (95% CI*[n]*)*	
IBS-QoL		
Crude	−.33 (−.38 to −.28)	**.000**
Model 1[o]	−.32 (−.36 to −.27)	**.000**
Model 2[p]	−.23 (−.27 to −.19)	**.000**
IBS-SSS		
Crude	1.39 (1.19-1.59)	**.000**
Model 1	1.34 (1.14-1.54)	**.000**
Model 2	1.16 (0.97-1.36)	**.000**
Anxiety		
Crude	0.03 (0.02 to 0.04)	**.000**
Model 1	0.03 (0.02 to 0.04)	**.000**
Depression		
Crude	0.03 (0.02-0.04)	**.000**
Model 1	0.03 (0.02-0.04)	**.000**

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Note: Bold values indicate statistical significance ($P < .05$).

[a]IBS = irritable bowel syndrome.

[b]IBS-QoL = IBS Quality of Life questionnaire (range 0-100; 100 indicates good quality of life[27]).

[c]Food score data are missing of 74 participants. The food score can range from 0 to 100: a score of 100 indicates that a participant responds to all products severely, and 0 indicates that a participant experienced no complaints to any of the triggers. Self-reported data are obtained using validated questionnaires such as the IBS-SSS,[12] IBS-QoL (range 0-100; 100 indicates good QoL),[27] Birmingham questionnaire,[25] Hospital Anxiety and Depression score (range from 0-21, score ≥8 indicates substantial anxious or depressive symptoms),[29,30] and the Bristol stool chart, which was used to compute the IBS subtypes,[24] based on the three most frequent habitual stool types. Multiple linear regression data are reported as ß with 95% CIs, including the *P* value of the ß. The food score was the independent variable, and IBS-QoL, IBS-SSS, anxiety and depression were dependent variables.

[d]*P* values indicate differences between groups (for example between IBS subtype groups), and were tested using χ^2 for categorical data, and for continuous data analysis of variance and Bonferroni post hoc for ≥3 groups or independent sample *t* test for ≤2 groups was used.

[e]SD = standard deviation.

[f]IBS-C = IBS with predominantly constipation.

[g]IBS-D = IBS with predominantly diarrhea.

[h]IBS-M = IBS alternating between diarrhea and constipation.

[i]IBS-U = IBS unspecified.

[j]IBS-SSS = Irritable Bowel Syndrome Symptom severity score.

[k]Mild IBS is ≤175, moderate IBS had a score between 175 and 300, and severe IBS is defined as ≥300).[12]

[l]Subgroups were defined based on a median split.

[m]Score ≥ 8 indicates substantial anxious or depressive symptoms),[29,30] and the Bristol stool chart was used to compute the IBS subtypes,[24] based on the 3 most frequent habitual stool types.

[n]CI = confidence interval.

[o]Model 1: age, sex and body mass index were added.

[p]Model 2: like model 1 + anxiety and depression.

[yz]Different superscripts indicate significance between the subgroups.

answers ranged between 0.5% and 46%. Response to yeast, spicy foods, potatoes, peppers, tomato, fish, citrus, alcohol, and coffee was significantly different between the IBS subtypes ($P < .05$), but absolute differences were small (Table 2, available at www.jandonline.org). When stratified for IBS severity, all dietary triggers except fish ($P = .085$) had significantly different prevalences of having no, mild, or severe complaints between mild, moderate, and severe IBS (Table 3, available at www.jandonline.org). In general, patients with severe IBS more often reported a severe response to a dietary trigger, and patients with mild IBS more often reported no complaints. Importantly, patients with both mild, moderate, and severe IBS identified the same 5 foods as most triggering, with a higher number of people in the severe group.

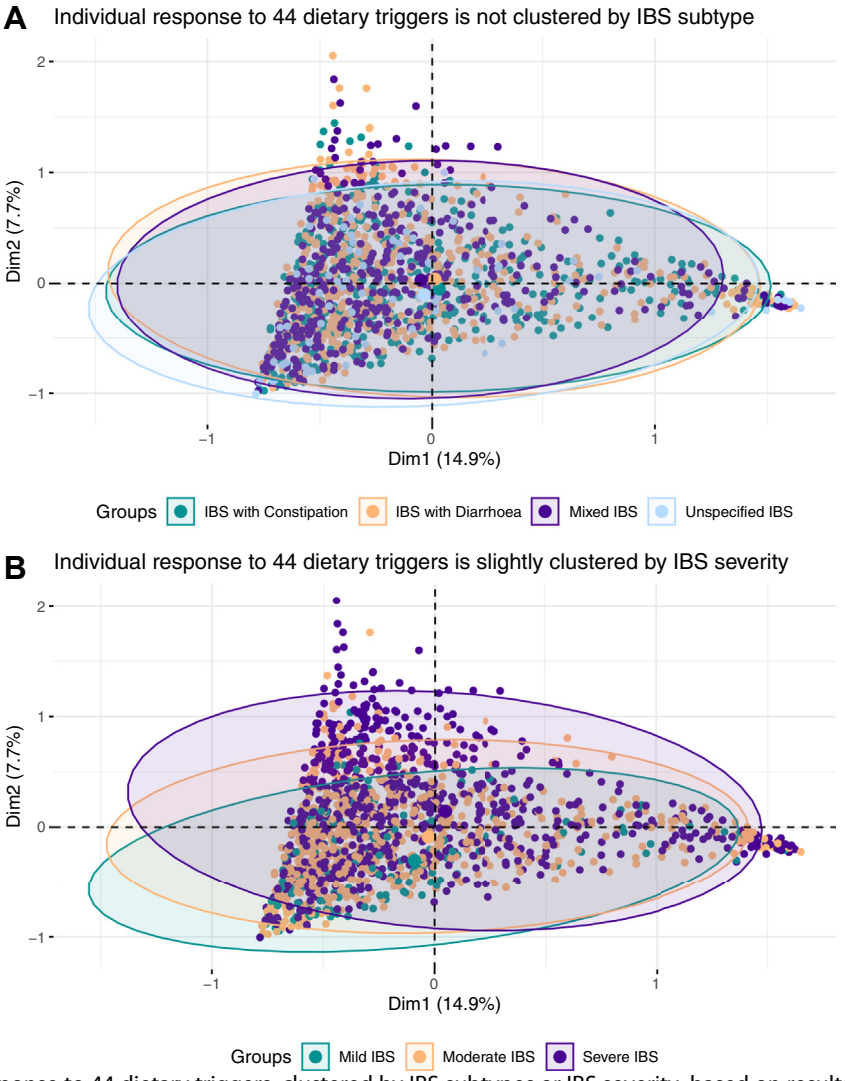

Figure 4. Individual response to 44 dietary triggers, clustered by IBS subtypes or IBS severity, based on results from a cross-sectional online survey in 1601 Dutch IBS patients. Legend: multiple correspondence analysis (MCA) score plot of the individual response regarding self-reported response to 44 dietary triggers. Answer options "I don't know" or "I don't use this" are included in the analysis. Ellipses are drawn based on a 95% confidence interval.

Associations Between Food Score and IBS Characteristics

Mean food score was 32.5 ± 20 and did not differ significantly between the IBS subtypes ($P = .073$). In contrast to IBS subtypes, the food score did differ significantly between IBS severity groups, with a higher food score for those with more severe IBS ($P < .001$). As shown in Table 4, stratification revealed that the food score was also significantly different between sex, experiencing anxious or depressive symptoms vs not, and relatively low vs high IBS-QoL, but not for age groups.

IBS-SSS, IBS-QoL, and anxiety and depression were significantly associated with the food score, even after adjustment of age, sex, and body mass index (Table 4). In other words, when a participant identified more food products as inducing severe symptoms, this was associated with a higher IBS severity and anxiety and depression score and a lower IBS-QoL. When depression and anxiety were added to the model, this did not change the results for IBS-SSS and IBS-QoL. IBS-QoL was also strongly associated with IBS-SSS ($\beta = -.118$ [$-.128$; $-.109$], $P < .001$); this remained when depression and anxiety were added to the model ($\beta = -.089$ [$-.098$; $-.080$], $P < .001$).

Multiple Correspondence Analysis for Crude Dietary Trigger Data

The MCA score plot (Figure 4A and 4B) provides a 2-dimensional explanation of variance between the responses to 44 dietary triggers, which showed a large variation between participants. Figure 4A shows no clustering of the IBS subtypes, indicating that the variation in response to dietary triggers is not explained by the IBS subtypes. Figure 4B again shows high variation between subjects but some clustering for patients with mild, moderate, and severe IBS. This indicates that IBS severity explained more variation in response to dietary triggers than the IBS subtypes, however much variation remains unexplained.

DISCUSSION

This study found no clinically relevant differences in self-reported dietary trigger response between IBS subtypes and IBS severity subgroups. Symptom severity seems more suitable for classifying the response to dietary triggers, since IBS-SSS score was positively associated with the food score. This was also shown in MCA analysis, where symptom severity explained the variation in crude dietary trigger data better when compared with IBS subtypes, by showing some clustering highlighted by the ellipses. However, no difference in the 5 most triggering foods was seen between IBS severity groups. This indicates that there is no need for a specific dietary treatment based on IBS subtype or IBS severity, but that dietary treatment needs to be individualized under supervision of a dietitian. The food score was statistically significantly different between men and women and those with or without signs of anxiety or depression, but differences were small, therefore clinical relevance is questionable. A larger difference in food score was seen between patients with a relatively low or high IBS-QoL, indicating that response to dietary triggers and IBS-QoL is associated.

Our study confirms previous findings that self-perceived food intolerance is not different between subtypes,[16] but this time in a much larger population. A unique aspect of our study was the nationwide inventory of IBS complaints regarding nutrition, making our power high and our results more representative of the heterogenous IBS population. Although 1163 (36%) participants dropped out, this is much lower than previously reported in online surveys.[37] Our Dutch population is similar to that in a previous European prevalence study, but with a slightly higher female predominance (82% compared with 63%).[2] Our age and sex population characteristics also resemble previous self-reported food intolerance data,[22,23] indicating our study population is representative of the IBS population, and our results are therefore applicable also to a non-Dutch IBS population. About one-third of our population discussed their diet with a dietitian, which is higher than the 12% found in an Irish study.[18] We did not find data on dietitian guidance in IBS in other countries, indicating the need for further research. The severity prevalence of our population is different than estimated by the Rome Foundation, as only 11% in our population was classified as mild IBS as opposed to the 45% that is estimated to be mild by the Rome Foundation.[38] However, previous studies have shown that severe IBS prevalence may range from 3% to 69%, depending on the population, and is likely to be underestimated.[39] Possibly, patients with severe IBS are more likely to participate in research than patients with mild IBS. Although our mild IBS prevalence is low, the number of patients and total sample size are sufficient to detect relevant differences between severity groups. In our study, we found that patients with severe IBS respond to more dietary triggers more severely. This seems plausible, regardless of the dietary trigger. Causality remains the question, whether the more severe response is a result of more severe IBS or the other way around. Due to our cross-sectional observational data, we cannot assess this.

Several known associations, such as between IBS-QoL and IBS-SSS, were confirmed in our study, suggesting our questionnaire was well constructed. When interpreting our results, we should not look only for significance; due to our large sample size, many of our results reached statistical significance, but not all might be of clinical relevance. One limitation of our study is that we predefined our 44 dietary triggers based on previous research, therefore narrowing the search beforehand. The amount of a dietary trigger consumed was not taken into account. The percentage of "I don't know" answers already ranged between 13% and 34% per food; probably a large percentage of patients with IBS do not know their personal "threshold" of response to a dietary trigger, making it impossible to take this into account in a self-reported survey. This unknown threshold factor again highlights the importance of dietetic counseling, which can be a method to investigate personal thresholds of dietary triggers. Moreover, data on dietary triggers are self-reported. Although it is known that the placebo effect of diet in IBS is high, self-reported dietary trigger response data remain valuable due to the high impact on daily life of self-perceived complaints after food consumption. Moreover, the sensation of complaints remains similar, regardless whether there are mechanistic reactions or not.

The products that were identified as most important dietary triggers are in line with previous research.[18,22,23] Our percentages of "I don't know" responses ranged between 13% and 34%, and "I don't use this" responses ranged between 0.5% and 46% for the different dietary triggers, which is quite high. However, for the 8 main food categories, only 0.6% to 15.5% of all participants reported excluding products due to their abdominal complaints. This indicates that the high percentages of "I don't use this" responses are not explained by the changes participants made in the diet due to symptoms, but that participants do not use these products for other reasons.

Similar to Simrén et al, we combined dietary trigger data and computed a continuous food score[22] to scale how severely a patient responds to a number of products. Our food score was different on 2 important points: first, Simrén et al did not provide the option to answer "don't use" or "don't know," which therefore may represent an over- or underestimation. Second, we standardized our food score to a scale of 0 to 100, which makes comparison between participants and future studies easier. However, the exclusion of "I don't know" and "I don't use this" answers may also be a disadvantage of our food score calculation. In theory, it is possible that a participant responds to one product severely but reports "I don't know" to all other products, resulting in a food score of 100. However, only 13% of the patients indicated "I don't know" or "I don't use this" for $\geq$30 of the 44 dietary triggers. When we repeated our analysis without these participants, this did not change our results (data not shown). In our study, we could not assess validity and reproducibility of the food score. However, assessing whether a patients with IBS truly responds to a trigger is difficult to test, and no gold standard currently has been developed. Moreover, we did not assess reproducibility, as IBS complaints are variable,[40] and therefore reproducibility may not be feasible or representative in this population.

Currently, most treatment plans are based on predominant stool type, but evidence for this is limited. Dietary fiber supplements are mainly advised for patients with IBS-C,[41] but most studies do not classify the IBS subtypes or only select patients with IBS-C in their recruitment.[42] In our study, we did not find any difference in reported response to grains,

bread, pasta, cereals, fruit, or vegetables between IBS subtypes. For greasy foods, advice is targeted toward patients with IBS-D and bloating[43]; however, Caldarella et al have shown that both patients with IBS-C and patients with IBS-D experience gastrointestinal symptoms after intraduodenal lipid infusion, but the type of complaints were different. Patients with IBS-C reported mainly cramping, while patients with IBS-D mostly experienced an urgency to defecate.[44] We did not find clinically relevant differences between response to dietary triggers between the subtypes, aiding the hypothesis that diet therapy should not be based solely the Rome IV classifications. Possibly, current classifications are not suitable for identifying which patient will respond to diet therapy. More mechanistic evidence is needed to understand differences in responses between patients. Current dietary treatment plans should be individualized, and the low prevalence of patients with IBS visiting a dietitian should be increased, as patients with IBS are also known to have a lower diet quality.[45]

We confirmed the importance of management of mental health when treating patients with IBS, as we showed high scores of anxiety and depression and an association with severity and IBS-QoL.[46,47] Although the food score was significantly associated with anxiety and depression, betas and R^2_{adj} were small, which makes its clinical relevance questionable. However, a recent study has shown that IBS symptom severity is strongly correlated with gastrointestinal-specific anxiety and quality of life, but not with general psychological features.[48] Possibly, general anxiety or depression is not associated with dietary trigger response, but gastrointestinal-specific anxiety is. Nevertheless, gastrointestinal-specific psychological factors are an important aspect to consider when treating patients with IBS, as unrelieved pain and functional impairment are risk factors for developing anxiety and depression.[49,50]

In conclusion, our study showed that patients from different IBS subtypes and IBS severity groups do not identify different self-reported dietary triggers. However, IBS severity is associated with the number and severity to which patients respond to a dietary trigger. Moreover, anxiety and depression are important in management of IBS symptoms, but there may not be a clinically relevant association with the response to dietary triggers. Our data do not support the need of a specific dietary advice for patients with different IBS subtype or IBS severity groups. Dietary treatments plans should be individualized under guidance of a dietitian, and the prevalence of patients with IBS visiting a dietitian needs to be increased. Moreover, IBS severity seems to be a better classifier than the Rome IV criteria for patients with IBS in regards to diet. Future studies should investigate new classifications that can identify responders for diet therapy.

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STATEMENT OF POTENTIAL CONFLICT OF INTEREST

No potential conflict of interest was reported by the authors.

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AUTHOR CONTRIBUTIONS

I. Rijnaarts drafted study concept and design, collected the data, performed statistical analysis and interpretation of the data, and drafted the manuscript. B. J. M. Witteman did study supervision and performed critical revision of the manuscript for important intellectual content. E. G. Zoetendal did study supervision and performed critical revision of the manuscript for important intellectual content. C. Govers obtained funding and performed critical revision of the manuscript for important intellectual content. N. J. W. de Wit obtained funding, did study supervision, and performed critical revision of the manuscript for important intellectual content. N. M. de Roos did study supervision and performed critical revision of the manuscript for important intellectual content. All authors reviewed and commented on subsequent drafts of the manuscript.

Table 2. Self-reported dietary triggers stratified for IBS[a] subtype, based on results from a cross-sectional online survey in 1601 Dutch patients with IBS[b]

Dietary triggers	Complaints	IBS-C[c] (n = 545)	IBS-D[d] (n = 557)	IBS-M[e] (n = 420)	IBS-U[f] (n = 79)	*P* value
		← *n (%)* →				
Grains (whole wheat, rye, barley)	None	168 (31)	161 (29)	116 (28)	26 (33)	.411
	Little	109 (20)	133 (24)	96 (23)	20 (25)	
	Severe	100 (18)	107 (19)	101 (24)	18 (23)	
Grains (spelt, gluten free)	None	237 (43)	228 (41)	182 (43)	41 (52)	.074
	Little	80 (15)	101 (18)	61 (15)	6 (8)	
	Severe	12 (2)	22 (4)	17 (4)	4 (5)	
Bread	None	176 (32)	169 (30)	130 (31)	31 (39)	.085
	Little	140 (26)	160 (29)	112 (27)	12 (15)	
	Severe	89 (16)	94 (17)	89 (21)	19 (24)	
Pasta	None	176 (32)	188 (34)	135 (32)	29 (37)	.626
	Little	129 (24)	124 (22)	106 (25)	18 (23)	
	Severe	80 (15)	100 (18)	86 (21)	15 (19)	
Cereal	None	185 (34)	167 (30)	139 (33)	26 (33)	.337
	Little	69 (13)	69 (12)	42 (10)	11 (14)	
	Severe	40 (7)	55 (10)	46 (11)	9 (11)	
Yeast	None	113 (21)	115 (21)	90 (21)	25 (32)	**.027**
	Little	74 (14)	53 (10)	49 (12)	7 (9)	
	Severe	40 (7)	67 (12)	38 (9)	6 (8)	
Spicy foods	None	138 (25)	97 (17)	82 (20)	20 (25)	**.007**
	Little	140 (26)	181 (32)	125 (30)	23 (29)	
	Severe	134 (25)	162 (29)	135 (32)	22 (28)	
Vegetables	None	292 (54)	299 (54)	227 (54)	45 (57)	.717
	Little	120 (22)	138 (25)	107 (26)	21 (27)	
	Severe	24 (4)	22 (4)	22 (5)	1 (1)	
Cabbage	None	105 (19)	94 (17)	80 (19)	23 (29)	.249
	Little	162 (30)	178 (32)	127 (30)	19 (24)	
	Severe	158 (29)	169 (30)	144 (34)	26 (33)	
Onion	None	140 (26)	118 (21)	88 (21)	20 (25)	.153
	Little	137 (25)	155 (28)	114 (27)	18 (23)	
	Severe	154 (28)	177 (32)	156 (37)	24 (30)	
Garlic	None	194 (36)	172 (31)	144 (34)	23 (29)	.372
	Little	95 (17)	124 (22)	90 (21)	18 (23)	
	Severe	92 (17)	104 (19)	83 (20)	16 (20)	

(*continued on next page*)

Table 2. Self-reported dietary triggers stratified for IBS[a] subtype, based on results from a cross-sectional online survey in 1601 Dutch patients with IBS[b] (*continued*)

Dietary triggers	Complaints	IBS-C[c] (n = 545)	IBS-D[d] (n = 557)	IBS-M[e] (n = 420)	IBS-U[f] (n = 79)	*P* value
Potatoes	None	317 (58)	293 (53)	223 (53)	50 (63)	**.011**
	Little	67 (12)	104 (19)	75 (18)	13 (17)	
	Severe	23 (4)	35 (6)	34 (8)	3 (4)	
Peppers	None	287 (53)	250 (45)	186 (44)	46 (58)	**.003**
	Little	85 (16)	108 (19)	77 (18)	10 (13)	
	Severe	38 (7)	63 (11)	53 (13)	5 (6)	
Tomato	None	323 (59)	307 (55)	258 (61)	58 (73)	**.016**
	Little	63 (12)	86 (15)	49 (12)	3 (4)	
	Severe	23 (4)	35 (6)	24 (6)	3 (4)	
Mushroom	None	266 (49)	266 (48)	211 (50)	39 (49)	.576
	Little	70 (13)	89 (16)	58 (14)	13 (17)	
	Severe	37 (7)	47 (8)	43 (10)	8 (10)	
Beans and legumes	None	128 (24)	136 (24)	111 (26)	26 (33)	.455
	Little	163 (30)	179 (32)	123 (29)	18 (23)	
	Severe	123 (23)	132 (24)	114 (27)	20 (25)	
Greasy foods	None	71 (13)	92 (17)	71 (17)	21 (27)	.084
	Little	158 (29)	152 (27)	107 (26)	17 (22)	
	Severe	194 (36)	215 (39)	167 (40)	28 (35)	
Sauces	None	122 (24)	120 (22)	100 (24)	23 (29)	.569
	Little	111 (20)	141 (25)	94 (22)	19 (24)	
	Severe	88 (16)	91 (16)	76 (18)	10 (13)	
Chocolate	None	235 (43)	228 (41)	183 (43)	46 (58)	.236
	Little	111 (20)	116 (21)	98 (23)	10 (13)	
	Severe	54 (10)	63 (11)	43 (10)	7 (9)	
Fries and fried foods	None	108 (20)	117 (21)	87 (21)	23 (29)	.211
	Little	162 (30)	152 (27)	116 (28)	19 (24)	
	Severe	125 (23)	159 (29)	122 (29)	17 (22)	
Chips	None	180 (33)	175 (31)	143 (34)	30 (40)	.580
	Little	111 (20)	133 (24)	87 (21)	15 (19)	
	Severe	56 (10)	66 (12)	57 (14)	8 (10)	
Dessert of animal protein	None	170 (31)	144 (26)	127 (30)	31 (39)	.053
	Little	102 (19)	101 (18)	78 (19)	6 (76)	
	Severe	97 (18)	120 (22)	85 (20)	15 (19)	
Plant-based dessert	None	209 (38)	227 (41)	159 (38)	36 (46)	.989
	Little	46 (8)	54 (10)	38 (9)	6 (8)	
	Severe	15 (3)	15 (3)	11 (3)	3 (4)	

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Table 2. Self-reported dietary triggers stratified for IBS[a] subtype, based on results from a cross-sectional online survey in 1601 Dutch patients with IBS[b] (*continued*)

Dietary triggers	Complaints	IBS-C[c] (n = 545)	IBS-D[d] (n = 557)	IBS-M[e] (n = 420)	IBS-U[f] (n = 79)	*P* value
Beef	None	265 (49)	269 (48)	240 (57)	42 (53)	.264
	Little	66 (12)	81 (15)	50 (12)	8 (10)	
	Severe	15 (3)	25 (4)	23 (5)	5 (6)	
Eggs	None	318 (58)	311 (56)	261 (62)	45 (57)	.242
	Little	88 (16)	108 (19)	68 (16)	15 (19)	
	Severe	25 (5)	31 (6)	20 (5)	0 (0)	
Processed meat	None	148 (27)	143 (26)	145 (35)	26 (33)	.371
	Little	64 (12)	86 (15)	61 (15)	9 (11)	
	Severe	34 (6)	44 (8)	30 (7)	8 (10)	
Pork	None	173 (32)	178 (32)	156 (37)	28 (35)	.950
	Little	65 (12)	78 (14)	66 (16)	12 (15)	
	Severe	35 (6)	37 (7)	29 (7)	8 (10)	
Chicken	None	349 (64)	345 (62)	300 (71)	53 (67)	.172
	Little	29 (5)	50 (9)	28 (7)	4 (5)	
	Severe	3 (1)	7 (1)	5 (1)	0 (0)	
Fish	None	343 (63)	330 (59)	266 (63)	47 (60)	**.020**
	Little	36 (7)	64 (12)	34 (8)	8 (10)	
	Severe	11 (2)	15 (3)	18 (4)	0 (0)	
Dairy	None	193 (35)	157 (28)	129 (31)	28 (35)	.106
	Little	124 (23)	130 (23)	104 (25)	15 (19)	
	Severe	91 (17)	122 (22)	89 (21)	13 (17)	
Cheese	None	274 (50)	247 (44)	220 (52)	37 (47)	.217
	Little	104 (19)	138 (25)	87 (21)	15 (19)	
	Severe	41 (8)	51 (9)	36 (9)	6 (8)	
Milk	None	172 (32)	138 (25)	112 (27)	28 (35)	.058
	Little	81 (15)	90 (16)	78 (19)	9 (11)	
	Severe	106 (19)	133 (24)	90 (21)	15 (19)	
Fruit	None	288 (53)	271 (49)	210 (50)	47 (60)	.242
	Little	141 (26)	153 (28)	121 (29)	15 (19)	
	Severe	26 (6)	37 (7)	32 (8)	4 (5)	
Orange	None	288 (53)	281 (50)	211 (50)	49 (62)	.060
	Little	57 (16)	92 (17)	70 (17)	10 (13)	
	Severe	46 (8)	54 (10)	51 (12)	1 (1)	

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Table 2. Self-reported dietary triggers stratified for IBS[a] subtype, based on results from a cross-sectional online survey in 1601 Dutch patients with IBS[b] (*continued*)

Dietary triggers	Complaints	IBS-C[c] (n = 545)	IBS-D[d] (n = 557)	IBS-M[e] (n = 420)	IBS-U[f] (n = 79)	*P* value
Apple	None	269 (49)	260 (47)	210 (50)	46 (58)	.193
	Little	82 (15)	100 (18)	74 (18)	6 (8)	
	Severe	82 (15)	79 (14)	60 (14)	8 (10)	
Banana	None	342 (63)	343 (62)	255 (61)	54 (68)	.370
	Little	71 (13)	77 (14)	62 (15)	7 (9)	
	Severe	34 (6)	24 (4)	30 (7)	3 (4)	
Grapes	None	295 (54)	273 (49)	212 (51)	40 (51)	.161
	Little	89 (16)	110 (20)	71 (17)	11 (14)	
	Severe	31 (6)	33 (6)	38 (9)	7 (9)	
Citrus	None	256 (47)	223 (40)	183 (44)	41 (52)	**.013**
	Little	95 (17)	104 (19)	73 (17)	10 (13)	
	Severe	36 (7)	63 (11)	46 (11)	3 (4)	
Alcohol	None	152 (28)	120 (22)	109 (26)	24 (30)	**.033**
	Little	148 (27)	138 (25)	110 (26)	18 (23)	
	Severe	70 (13)	107 (19)	61 (15)	12 (15)	
Coffee	None	203 (37)	170 (31)	164 (39)	26 (33)	**.040**
	Little	143 (26)	152 (27)	90 (21)	19 (24)	
	Severe	45 (8)	66 (12)	48 (11)	7 (9)	
Tea	None	413 (76)	401 (72)	309 (74)	62 (79)	.436
	Little	37 (7)	53 (10)	39 (9)	5 (6)	
	Severe	6 (1)	7 (1)	9 (21)	1 (1)	
Soda	None	103 (19)	109 (20)	85 (20)	15 (19)	.969
	Little	100 (18)	102 (18)	82 (20)	12 (15)	
	Severe	51 (9)	52 (9)	44 (11)	4 (5)	
Soda, light	None	93 (17)	99 (18)	81 (19)	13 (17)	.982
	Little	64 (12)	67 (12)	55 (13)	10 (13)	
	Severe	54 (10)	50 (9)	41 (10)	5 (6)	
Nuts and seeds	None	296 (54)	313 (56)	218 (52)	42 (53)	.468
	Little	98 (18)	96 (17)	87 (21)	11 (14)	
	Severe	24 (4)	31 (6)	5 (6)	5 (6)	

Note: Bold values indicate statistical significance ($P < .05$).

[a]IBS = irritable bowel syndrome.

[b]Participants who indicated "I don't know" or "I do not use this product" are not shown. Data were tested using χ^2.

[c]IBS-C = IBS with predominantly constipation.

[d]IBS-D = IBS with predominantly diarrhea.

[e]IBS-M = IBS alternating between diarrhea and constipation.

[f]IBS-U = IBS unspecified.

Table 3. Self-reported dietary triggers stratified for IBS[a] severity, based on results from a cross-sectional online survey in 1601 Dutch patients with IBS[b]

Dietary triggers	Complaints	Mild IBS (n = 174)	Moderate IBS (n = 661)	Severe IBS (n = 766)	*P* value
		← *n (%)* →			
Grains (whole wheat, rye, barley)	None	81 (47)	224 (34)	166 (22)	**.000**
	Little	31 (18)	150 (23)	177 (23)	
	Severe	16 (9)	108 (16)	202 (26)	
Grains (spelt, gluten free)	None	89 (51)	299 (45)	300 (39)	**.000**
	Little	11 (6)	89 (13)	148 (19)	
	Severe	3 (2)	15 (2)	37 (5)	
Bread	None	84 (48)	239 (36)	183 (24)	**.000**
	Little	38 (22)	173 (26)	213 (28)	
	Severe	18 (10)	89 (13)	184 (24)	
Pasta	None	86 (49)	248 (37)	194 (25)	**.000**
	Little	30 (17)	149 (22)	198 (26)	
	Severe	15 (9)	85 (13)	181 (24)	
Cereal	None	82 (47)	246 (37)	189 (25)	**.000**
	Little	13 (7)	66 (10)	112 (15)	
	Severe	11 (6)	45 (7)	94 (12)	
Yeast	None	52 (30)	166 (25)	125 (16)	**.000**
	Little	20 (11)	77 (12)	86 (11)	
	Severe	10 (6)	49 (7)	93 (12)	
Spicy foods	None	60 (34)	149 (22)	128 (17)	**.000**
	Little	53 (30)	209 (32)	207 (27)	
	Severe	19 (11)	171 (26)	263 (34)	
Vegetables	None	128 (74)	384 (58)	351 (46)	**.000**
	Little	20 (11)	138 (21)	228 (30)	
	Severe	2 (1)	17 (3)	50 (6)	
Cabbage	None	57 (33)	137 (21)	108 (14)	**.000**
	Little	53 (30)	218 (33)	215 (28)	
	Severe	32 (18)	178 (27)	387 (37)	
Onion	None	68 (39)	174 (26)	124 (16)	**.000**
	Little	42 (24)	185 (28)	197 (26)	
	Severe	36 (21)	185 (28)	290 (38)	
Garlic	None	85 (49)	250 (38)	198 (26)	**.000**
	Little	27 (15)	127 (19)	173 (23)	
	Severe	20 (11)	103 (16)	172 (23)	

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Table 3. Self-reported dietary triggers stratified for IBS[a] severity, based on results from a cross-sectional online survey in 1601 Dutch patients with IBS[b] (*continued*)

Dietary triggers	Complaints	Mild IBS (n = 174)	Moderate IBS (n = 661)	Severe IBS (n = 766)	*P* value
Potatoes	None	118 (68)	397 (60)	368 (48)	**.000**
	Little	18 (10)	94 (14)	147 (19)	
	Severe	6 (3)	24 (4)	65 (8)	
Peppers	None	107 (61)	340 (51)	322 (42)	**.000**
	Little	21 (12)	105 (16)	154 (20)	
	Severe	12 (7)	61 (9)	86 (11)	
Tomato	None	123 (71)	424 (64)	399 (52)	**.000**
	Little	10 (6)	67 (10)	124 (16)	
	Severe	7 (4)	29 (4)	49 (6)	
Mushroom	None	108 (62)	353 (53)	321 (42)	**.000**
	Little	17 (10)	77 (12)	136 (18)	
	Severe	7 (4)	47 (7)	81 (11)	
Beans and legumes	None	63 (36)	182 (27)	156 (20)	**.000**
	Little	57 (33)	202 (31)	224 (29)	
	Severe	29 (17)	145 (22)	215 (28)	
Greasy foods	None	38 (22)	106 (16)	111 (14)	**.000**
	Little	56 (32)	196 (30)	182 (24)	
	Severe	42 (24)	239 (36)	323 (42)	
Sauces	None	63 (36)	170 (26)	132 (17)	**.000**
	Little	37 (21)	136 (21)	192 (25)	
	Severe	13 (7)	93 (14)	159 (21)	
Chocolate	None	100 (57)	320 (48)	272 (35)	**.000**
	Little	25 (14)	128 (19)	182 (24)	
	Severe	9 (5)	56 (8)	102 (13)	
Fries and fried foods	None	59 (34)	137 (21)	139 (18)	**.000**
	Little	49 (28)	198 (30)	202 (26)	
	Severe	19 (11)	157 (24)	247 (32)	
Chips	None	83 (48)	226 (34)	219 (29)	**.000**
	Little	23 (13)	148 (22)	175 (23)	
	Severe	11 (6)	54 (8)	122 (16)	
Dessert of animal protein	None	84 (48)	222 (34)	166 (22)	**.000**
	Little	27 (15)	110 (17)	150 (20)	
	Severe	21 (12)	110 (17)	186 (24)	

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Table 3. Self-reported dietary triggers stratified for IBS[a] severity, based on results from a cross-sectional online survey in 1601 Dutch patients with IBS[b] (*continued*)

Dietary triggers	Complaints	Mild IBS (n = 174)	Moderate IBS (n = 661)	Severe IBS (n = 766)	*P* value
Plant-based dessert	None	83 (48)	282 (43)	266 (35)	**.000**
	Little	9 (5)	37 (6)	98 (13)	
	Severe	2 (1)	11 (2)	31 (4)	
Beef	None	113 (65)	365 (55)	338 (44)	**.000**
	Little	11 (6)	69 (10)	125 (16)	
	Severe	2 (1)	20 (3)	46 (6)	
Eggs	None	126 (72)	406 (61)	403 (53)	**.000**
	Little	10 (11)	104 (16)	155 (20)	
	Severe	5 (3)	28 (4)	43 (6)	
Processed meat	None	76 (44)	226 (34)	160 (21)	**.000**
	Little	9 (5)	91 (14)	120 (16)	
	Severe	6 (3)	33 (5)	77 (10)	
Pork	None	84 (48)	251 (38)	200 (6)	**.000**
	Little	10 (6)	82 (12)	129 (17)	
	Severe	5 (3)	38 (6)	66 (9)	
Chicken	None	129 (74)	447 (68)	471 (61)	**.000**
	Little	5 (3)	32 (5)	74 (10)	
	Severe	0 (0)	7 (1)	8 (1)	
Fish	None	118 (68)	437 (66)	431 (56)	.085
	Little	10 (6)	53 (8)	79 (10)	
	Severe	6 (3)	18 (3)	20 (3)	
Dairy	None	86 (49)	242 (37)	179 (23)	**.000**
	Little	35 (20)	153 (23)	185 (24)	
	Severe	23 (13)	105 (16)	187 (24)	
Cheese	None	114 (65)	354 (54)	310 (40)	**.000**
	Little	24 (14)	127 (19)	193 (25)	
	Severe	8 (5)	48 (7)	78 (10)	
Milk	None	74 (42)	211 (32)	165 (21)	**.000**
	Little	21 (12)	112 (17)	125 (16)	
	Severe	24 (14)	126 (19)	194 (25)	
Fruit	None	106 (61)	383 (58)	327 (43)	**.000**
	Little	30 (17)	159 (24)	241 (31)	
	Severe	7 (4)	22 (3)	70 (9)	

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Table 3. Self-reported dietary triggers stratified for IBS[a] severity, based on results from a cross-sectional online survey in 1601 Dutch patients with IBS[b] (*continued*)

Dietary triggers	Complaints	Mild IBS (n = 174)	Moderate IBS (n = 661)	Severe IBS (n = 766)	*P* value
Orange	None	110 (63)	368 (56)	351 (46)	**.000**
	Little	16 (9)	107 (16)	136 (18)	
	Severe	6 (3)	44 (7)	102 (13)	
Apple	None	99 (57)	360 (54)	326 (43)	**.000**
	Little	19 (11)	103 (16)	140 (18)	
	Severe	14 (8)	71 (11)	144 (19)	
Banana	None	125 (72)	437 (66)	432 (56)	**.000**
	Little	7 (4)	82 (12)	128 (17)	
	Severe	8 (5)	24 (4)	59 (8)	
Grapes	None	105 (60)	368 (56)	347 (45)	**.000**
	Little	20 (11)	112 (17)	149 (19)	
	Severe	3 (2)	29 (4)	77 (10)	
Citrus	None	90 (52)	336 (51)	277 (36)	**.000**
	Little	19 (11)	103 (16)	160 (21)	
	Severe	6 (3)	48 (7)	94 (12)	
Alcohol	None	70 (46)	181 (27)	144 (19)	**.000**
	Little	41 (24)	197 (30)	176 (23)	
	Severe	5 (3)	104 (16)	141 (19)	
Coffee	None	89 (51)	239 (36)	235 (31)	**.000**
	Little	36 (21)	186 (28)	182 (24)	
	Severe	6 (3)	64 (10)	96 (12)	
Tea	None	145 (83)	512 (77)	528 (69)	**.000**
	Little	6 (3)	42 (6)	86 (11)	
	Severe	0 (0)	4 (1)	19 (2)	
Soda	None	54 (31)	136 (21)	122 (16)	**.000**
	Little	21 (12)	118 (18)	157 (20)	
	Severe	5 (3)	50 (8)	96 (12)	
Soda, light	None	48 (28)	126 (19)	112 (15)	**.000**
	Little	13 (7)	78 (12)	105 (14)	
	Severe	8 (5)	49 (7)	93 (12)	
Nuts and seeds	None	115 (66)	377 (57)	377 (49)	**.006**
	Little	19 (11)	118 (18)	155 (20)	
	Severe	8 (5)	37 (6)	44 (6)	

Note: Bold values indicate statistical significance ($P < .05$).

[a]IBS = irritable bowel syndrome.

[b]Participants who indicated "I don't know" or "I do not use this product" are not shown. Data were tested using χ^2.