

The feasibility, usability, and clinical utility of traditional paper food and symptom journals for patients with irritable bowel syndrome

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Abstract

Background: Paper food and gastrointestinal (GI) symptom journals are used to help irritable bowel syndrome (IBS) patients determine potential trigger foods. The primary aim of this study was to evaluate the feasibility, usability, and clinical utility of such journals as a data collection tool. A secondary aim was to explore a method for analyzing journal data to describe patterns of diet and symptoms.

Methods: Participants (N=17) were asked to log three sets of 3-day food and symptom journals over a 15-day period. Feasibility was evaluated by journal completion rates, symptom logging compliance, and logging fatigability. The feasibility, usability, and clinical utility of journaling were also assessed by a customized evaluation and exit interview. For each journal, regression analyses were conducted to examine relationships between key meal nutrients and subsequent symptoms.

Key Results: Most participants were young (mean age 35±12) Caucasian (N=13) women (N=14). Journal completion rates were 100% for all participants with no logging fatigability. Over half perceived paper journaling of food and symptoms as feasible, usable, and clinically useful. Thirteen participants demonstrated a strong association with at least one symptom and meal nutrient. Patterns of associations differed among participants.

Conclusions and Inferences: Paper journaling of food and GI symptoms for 9 days over a 15-day period appeared to be a feasible and usable data collection tool for IBS patients. Over half perceived journaling as at least somewhat clinically useful. Findings from this study support the anecdote that food trigger(s) and associated symptom(s) vary for each individual.

KEYWORDS

alternative medicine, Irritable Bowel Syndrome, nutrition, food intolerances

1 | INTRODUCTION

Food and gastrointestinal (GI) symptom paper journals are used in clinical practice to help patients with irritable bowel syndrome (IBS) determine their trigger foods. However, the feasibility and usability of such paper journals as a data collection tool have not yet been investigated. Feasibility is evaluated by completion and compliance rates (i.e., delayed entries, logging fatigability). Usability is the perceived ease-of-use and learnability of a process or technology. Such information

is critical to ensure the validity, reliability, and therefore clinical utility of the data collected from such journals. In this study, we defined clinical utility as the usefulness of paper journaling in identifying food triggers and managing IBS symptoms. Although previous dietary IBS intervention studies have required participants to regularly log either food and/or symptoms in journals, none reported journal completion and/or compliance rates.¹⁻⁴

To our knowledge, no other study has also explored IBS patient perspectives on the feasibility, usability, and clinical utility of paper

food and GI symptom journals. Measuring feasibility and usability alone would not provide clinicians with solutions on how to improve journaling. More importantly, those measures alone would fail to give clinicians insight on how to make journaling a more clinically meaningful experience for their patients with IBS. Such feedback could help highlight the current strengths and barriers of journaling. It could also help providers develop journaling practices that patients with IBS would not only adhere to but also find clinically useful.

Other studies have reported the feasibility and usability of paper journaling in other patient populations. For food journaling, compliance rates decreased as more logging days were performed, especially beyond a 7-day journaling period.⁵ For symptom journaling, overall compliance rates ranged from 11% to 55% with evidence of logging fatigue.⁶⁻⁹ A recent study by our group was able to demonstrate the feasibility and usability of an *electronic* food and GI symptom journal for 11 patients with IBS over a 2-week period.¹⁰ Daily completion and 24-hour compliance rates were $\geq 78\%$. During exit interviews, participants reported increased self-awareness and accountability from using the journal, but thought it would be more clinically useful if it provided more data analysis and dietary guidance.

Indeed, one of the main objectives of journaling has been to increase self-awareness by capturing one's baseline dietary behaviors and GI symptoms. However, the act of journaling itself has been known to change one's behavior, thereby affecting what it intended to measure in the first place. For example, in dietary recall studies, logging meals affected both the types and quantities of foods consumed during the study.¹¹ The most frequent reasons for these changes were to decrease social embarrassment and the burden of logging.^{11,12} The tendency of changing dietary habits while logging could, however, be seen as a clinical advantage. The self-awareness that comes from journaling has led to improvements in health end points for several patient populations.^{8,9,13,14} Therefore, journaling food and GI symptoms could itself result in an overall reduction in GI symptoms for patients with IBS.

Even if these paper journals are found to be feasible and usable, their clinical utility could be limited because they are hard for providers to interpret. No standardized methodology currently exists for determining trigger foods from these journals. In IBS, the most common (and weakly validated) method used is to observe increases in symptom severity logging with serial multiday reintroduction of select trigger foods after a 2- to 4-week elimination diet.^{15,16} Because this method is tedious and lengthy and does not represent baseline dietary loads of trigger foods, we previously introduced a method using regression analyses to highlight potential food nutrient triggers using pilot data collected from our electronic journal.¹⁰ We wanted to further explore this method with data collected from "traditional" paper journals plus standard dietary protocols (e.g., detailed meal descriptions, verbal clarification of journal entries, less than three consecutive days of logging), which we could loosely term as the "gold standard" of journaling.¹² We wanted to capture the most accurate data possible to maximize our ability to describe individualized patterns of food and GI symptoms. Anecdotally, patients with IBS have individualized trigger foods, and food and symptom journals can help identify such trigger

Key Points

- IBS patients and providers sometimes use paper food and gastrointestinal symptom journal to help identify trigger foods.
- A recent pilot study found that a smartphone IBS food and symptom journal application was a feasible and usable data collection tool.
- Traditional paper IBS food and symptom journals also appear to be feasible and usable data collection tools. Most patients with IBS perceive paper journaling as clinically useful.

foods. However, these assumptions are currently based on limited evidence and expert opinions.^{15,17}

The primary aims of this study were to evaluate the feasibility and usability of a paper food and GI symptom journal as a data collection tool and to explore the clinical utility of such journals for patients with IBS. A secondary aim was to explore whether logging one's food and GI symptoms for 9 days over a 15-day period had an impact on IBS symptom severity. Thirdly, this study further explored a method for discovering individualized relationships between food nutrients and GI symptoms using data collected from paper journals. It is our hope that this method could help guide IBS patients, on an individual level, regarding which nutrients are and are not personal symptom triggers.

2 | METHODS

2.1 | Recruitment and eligibility

2.1.1 | Recruitment

Volunteers with IBS were recruited through clinic advertisements, physician referrals, and mailings from two gastroenterology clinics associated with an university-based academic center (University of Washington Medical Center, Seattle, WA; University of Washington Eastside Specialty Center, Bellevue, WA) between March 2014 and February 2015. Figure 1 summarizes the participant enrollment flow process. Human participants' institutional review board approval was obtained prior to enrolling participants (March 2014). Monetary compensation was provided.

2.1.2 | Eligibility

Participants were assessed for eligibility via a telephone screen and chart review. To be included, men and women had to be between 18 and 70 years of age, be comfortable reading and writing in English, meet the Rome III criteria for IBS, and experience current IBS symptoms over the past month.¹⁸ Participants were excluded if they had a history of coexisting GI pathology (e.g., inflammatory bowel disease, celiac disease), GI surgery within 6 months prior to enrollment (e.g., bowel resection), renal or reproductive pathology (e.g., endometriosis, prostate cancer), severe fibromyalgia, type 1 or 2 diabetes mellitus,

corresponding date and time. Food/drink details included brand names, food preparation (e.g., baked, broiled, fried), portion sizes, and additives (e.g., butter, oil, dressings, salt). They were also asked to log peak GI symptoms (abdominal pain, bloating, diarrhea, constipation) since their prior meal entry on a scale from 0 to 3 (0=none, 1=mild, 2=moderate, 3=severe). This symptom scale was based on the symptom logging templates from the book "Master your IBS: An 8-Week Plan to Control the Symptoms of IBS."¹⁹ Participants were expected to log their GI symptoms with every meal entry and before bedtime. Participants were instructed to log a total of three sets of 3-day meal and GI symptom journals over a 15-day period (9 days total). We selected this time period based on the average number of journaling days typically recommended by dietitians in clinical practice: between 5 and 14 days.^{12,19,20} To avoid data entry fatigue, the recommended scheduling of these sets of journals was a minimum of 3 days "on" (logging) followed by 3 days "off" (not logging).^{11,12} All female patients were asked to begin this 15-day journaling period 6 days after the start of their menses. A research team member reviewed each set of 3-day journals to clarify any missing or incomplete entries.

After the study intervention, participants were asked to complete the IBS-SSS and a customized exit evaluation. In the absence of a standardized instrument, J.Z., J.K., E.B., and C.C. developed a 23-question evaluation (5-point Likert type scale statements, multiple-choice questions, and open-ended questions) to explore the feasibility, usability, and clinical utility of the paper journal. A panel of experts in the field of questionnaire design reviewed the evaluation draft for face validity and provided feedback for edits and modifications. Five healthy pilot participants from the community then completed the revised evaluation and provided feedback on the structure and their comprehension of the evaluation, which contributed to its final edits. Qualitative

feedback on a participant's study experience was also obtained via a semi-structured in-person interview. Participants otherwise continued their usual medical care throughout the study.

2.3 | Primary outcomes

All food and GI symptom data for each participant's paper journal and questionnaire responses were entered into an Excel spreadsheet (Microsoft, Redmond, WA, USA) for storage. All statistical analyses were conducted using the R Statistical Software v2.15.2.²¹

2.3.1 | Feasibility, usability, and clinical utility

The feasibility of the paper journal as a data collection tool was assessed by journal completion rates, symptom logging compliance, and logging fatigability. Journal completion rates were calculated by dividing the number of actual journal entry days over the nine expected journal entry days within a 15-day period. Symptom logging compliance was determined by the number of actual over expected number of symptom entries (one with every meal entry and one before bedtime). A participant was considered "non-compliant" with their symptom logging if they did not meet 100% symptom logging compliance. Logging fatigability was determined by assessing whether any drop-offs in either daily meal or symptom entries occurred with each subsequent 3-day journal set using Welch's unequal variances *t*-tests.

Exit evaluation

Participant responses to select questions from the exit evaluation were used to evaluate the paper journal's feasibility, usability, and clinical utility (Fig. 3). Clinical utility was assessed by how much participants

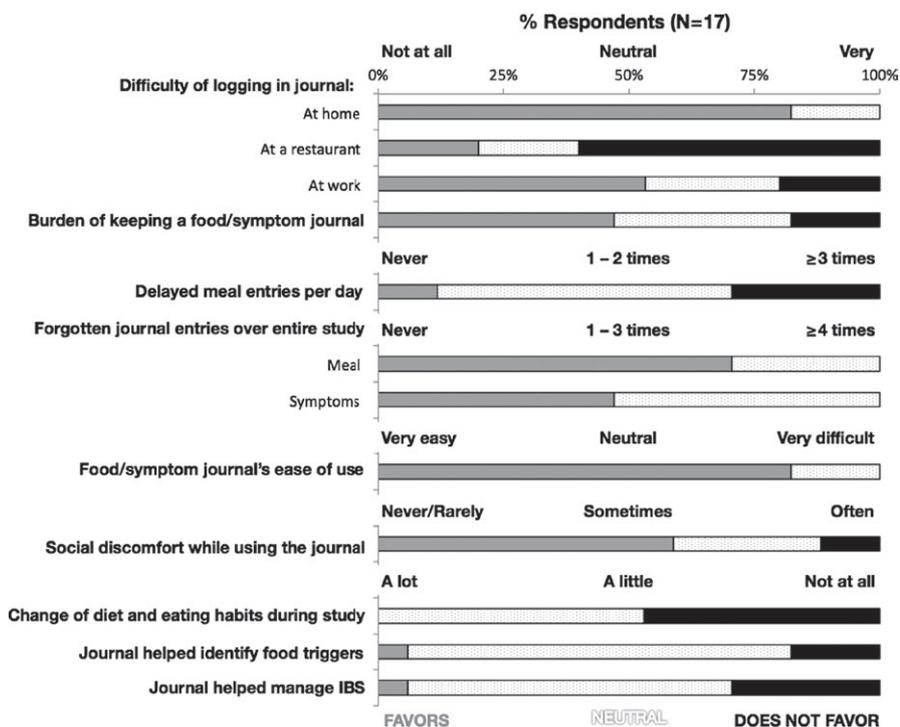


FIGURE 3 Responses to select evaluation questions regarding paper journal feasibility, usability, and clinical utility. IBS, irritable bowel syndrome.

felt that journaling helped them identify food triggers and manage their IBS symptoms. Welch's unequal variances *t*-tests were applied to determine whether any differences in responses to the Likert type scale statements existed between participants who did or did not identify at least one food trigger prior to the study intervention.

Semi-structured interview

A semi-structured exit interview was also conducted to obtain qualitative data on participant perspectives on the feasibility, usability, and clinical utility of paper journals. The following types of open-ended questions were asked: (1) "What was your motivation for joining this study?" (2) "What made journaling challenging?" (3) "What were you hoping to learn from journaling?" and (4) "What did you learn from journaling?" Emerging generalized themes from these responses were identified to reflect participant attitudes by J.Z. Responses were categorized into these theme(s) by a manual indexing system by J.Z. C.C. confirmed the emerging themes and categorizations of each participant's interview transcript. Any disagreements on the themes and/or categorization were resolved by a discussion between J.Z. and C.C.

2.4 | Secondary outcomes

2.4.1 | Impact on GI distress

To explore the potential impact of using a paper journal on GI distress in our participants, IBS-SSS scores were compared pre- and postintervention. The IBS-SSS is an IBS-specific instrument that is sensitive to change in symptoms over time.²² Responders rate retrospectively, for the past 10 days, abdominal pain severity and frequency (separate ratings), bloating severity, dissatisfaction with GI habits, and life interference from GI symptoms. These five ratings are totaled to obtain an overall IBS severity score with a maximum score of 500. According to the scale developers, a 50-point or greater change on this scale is considered clinically meaningful.²² Welch's unequal variances *t*-tests were applied to determine any significant differences in IBS-SSS pre- and postintervention.

2.4.2 | Patterns of meals and GI symptoms

Trained research dietitians collected and analyzed dietary intake data using Nutrition Data System for Research (NDSR) software version 2013, developed by the Nutrition Coordinating Center, University of Minnesota, Minneapolis, MN. For specific meal nutrients, refer to Appendix 1. For missing information, such as portion sizes and/or unfamiliar food products, standard assumptions were made according to NDSR's "Data Entry Rules."²³

For each participant's journal, regression analyses were conducted to examine relationships between GI symptoms and preceding meal nutrients (logged within the 4-hour window before a recorded symptom). This 4-hour window was based on prior IBS patient reports on the timing of symptoms following trigger food ingestion.²⁴⁻²⁶ In a study by Simren et al., of the 209 patients with IBS who attributed individual foods to their GI symptoms, 93% reported the onset of the

GI symptoms occurring within 3 hours after eating.²⁵ In a study by Posserud et al. with 67 IBS patients, peak GI symptoms (gas, bloating, discomfort, fullness, abdominal pain) occurred by 60 minutes.²⁶ The data matrix for regression analysis consisted of symptom ratings as dependent variables with independent variables corresponding to a summation of nutrient indexes consumed in meals. If more than one meal was entered within the 4-hour window before a recorded symptom, we summed the nutrients for all of the meals in that window. We excluded GI symptom entries from our analyses if there was no corresponding meal entry in the 4 hours prior to its entry.

Prior to running regression analyses, a feature selection particular to each patient's diet was performed. Food nutrients have a high degree of collinearity due to both natural co-occurrences (e.g., foods with higher total fat tend to have higher total calories) and personal dietary habits (e.g., some people always drink their caffeinated beverages with milk and a sweetener). However, linear regressions assume a high degree of independence between predictors. Therefore, nutrients that had high pair-wise correlations (>0.75) with other nutrients were highlighted, and the nutrient(s) with the highest average correlation of the highly correlated nutrients were removed. Regressions were then performed with these selected nutrient(s). We considered a nutrient to be strongly associated with a GI symptom if the *P*-value was $\leq .05$ and to be very strongly associated if the *P*-value was $\leq .001$.

3 | RESULTS

3.1 | Participants

Figure 1 summarizes the participant recruitment pathway from screening to study completion. Seventeen participants were analyzed (18 included). Demographics and baseline clinical characteristics are provided in Table 1. Most participants were woman ($n=14$), Caucasian ($n=13$), and college educated ($n=16$) with a mean age of 36 years ($SD=12$). The predominant GI pattern was diarrhea ($n=11$) of moderate symptom severity ($n=11$) based on the IBS-SSS.

At baseline, most participants agreed that their GI symptoms were often (>25% of the time) made worse by eating ($n=15$) and were able to identify specific foods that seemed to trigger their GI symptoms ($n=14$). Most ($n=12$) were already following exclusionary diets to help manage their IBS (average food(s) eliminated from diet= 4.5 per participant, $SD=1.8$). The most common foods excluded were as follows: high-fat, greasy foods ($n=8$); wheat-based ($n=7$); dairy ($n=7$); gluten-free/restricted ($n=6$); alcohol ($n=6$); raw vegetables/fruits ($n=5$); and fermentable oligo-, di-, monosaccharides, and polyols ($n=4$).

3.2 | Primary outcomes

3.2.1 | Feasibility, usability, and clinical utility

All participants ($N=17$) completed 9 days of food and GI symptom entries within a 15-day period. On average, participants completed 4.6 ± 1.8 (range 2–10) meal and 5.5 ± 1.8 (range 3–11) symptom entries a day. Six participants were non-compliant with logging at least one of

TABLE 1 Baseline demographics and clinical characteristics

Demographics	N=17
Age, mean (SD)	36 (12)
Gender, female, n	14
Race, white, n	13
College educated or above, n	16
IBS characteristics	
Years since IBS diagnosis, mean (SD)	6.8 (5.2)
Predominant bowel pattern ^a	
IBS subtype, diarrhea, n	11
IBS subtype, constipation, n	2
IBS subtype, mixed, n	4
IBS baseline severity based on IBS-SSS ^b	
IBS-SSS baseline score, mean (SD)	277.9 (77.3)
Mild, n	0
Moderate, n	11
Severe, n	6

IBS: irritable bowel syndrome; IBS-SSS: IBS-Symptom Severity Score; SD: standard deviation.

^aBased on Rome III definition.²¹

^bIBS-SSS score severity scale: mild 75–175, moderate 175–300, severe >300.²³

their GI symptoms, where half (n=3) forgot to log their symptoms at bedtime and the other half (n=3) forgot while logging their food. No significant drop-offs were observed in meal and symptom entries with each subsequent 3-day journal set (data not shown; *p*=NS).

Exit evaluation

Participant responses to select survey questions regarding the feasibility, usability, and clinical utility of keeping a food and GI symptom paper journal are shown in Fig. 3. Participants found it less difficult to log their meals/symptoms at home (M=1.8, SD=0.8) than at work (M=2.5, SD=1.0; *P*<.001) or at a restaurant (M=3.5, SD=1.1; *P*<.05). There were no significant differences in the perceived difficulty of logging the first versus the second versus the third set of 3-day journals (data not shown). The most burdensome aspects of using the paper journal were as follows: logging meal details (n=9), carrying the journal (n=5), not knowing meal details such as portion sizes or ingredients (n=5), and recalling meal/symptom details (n=5).

Most participants logged their food entries either immediately (n=5), 15 minutes (n=3), or 1 hour (n=5) after eating, based on their evaluation responses. The most common reasons participants did not log a meal were as follows: forgetfulness (n=8), social contexts (n=5), journal not handy (n=4), and only ate or drank a small amount (n=3). The most common reasons participants did not log symptoms were as follows: forgetfulness (n=7), journal not handy (n=2), social contexts (n=2), and unable to recall recent symptoms (n=2).

For this study, most participants took less than 15 minutes per day to log their food (n=12) and less than 5 minutes per day to log their GI symptoms (n=14). Figure S1 displays the distribution of the maximum

time participants were willing to commit, both daily and long term, to using a paper journal.

Nine participants described changing their usual eating habits/diet at least a little during the study. The reasons for this change were to ease the burden of logging (grouped meals, less complex meals) (n=4/9) and to test triggers (ate more variety or frequently) (n=3/9). No significant differences were found in the responses to the Likert type scale evaluation statements between participants who did and did not identify prestudy food triggers (data not shown; *P*=NS).

Semi-structured interview

Most participants were motivated to join this study to reduce their personal IBS symptoms (n=9), contribute to IBS research (n=8), and help other patients suffering from IBS (n=7). The majority of participants reported a prior journaling experience (n=11), mostly with diet (n=9/11) and symptoms (n=4/11). The themes that emerged when participants were asked about what made journaling challenging, what they hoped to learn from journaling, and what they did learn from journaling are displayed in Table 2. Select themes are supported with representative quotes to further highlight their meaning. The most common triggers participants would also like to log in the future are sleep (n=4), other symptoms/signs such as stool consistency and headaches (n=3), exercise/activity level (n=3), medications (n=2), and speed of food consumption (n=2).

3.3 | Secondary outcomes

3.3.1 | Impact on GI distress

The mean change in IBS-SSS was 6.9 (SD=56.6), but this was not statistically significant. Four participants had a clinically significant IBS-SSS score decrease of 50 points, according to scale developers.²²

3.3.2 | Patterns of meals and GI symptoms

Thirteen participants demonstrated at least one strong association (*P*≤.05) between a GI symptom and meal nutrient. Patterns of association differed among individual participants (Table 3). The mean number of associations was two (range 0–11; N=17).

4 | DISCUSSION

Paper journaling of food and GI symptoms for 9 days over a 15-day period appeared to be a feasible and usable data collection tool for IBS patients. Over half perceived journaling as at least somewhat clinically useful. Journaling alone did not appear to affect an IBS patient's overall GI symptoms, at least immediately following this study or for our study duration. Finally, this study further explored a method to identify individualized relationships between GI symptoms and meal nutrients, finding significant relationships for most of our participants.

Our interdisciplinary group has recently developed a smartphone application (app) to replace the traditional paper food and GI symptom

TABLE 2 Most common emerging themes from open-ended questions

What made tracking challenging?	N=17
Difficult assessment	14
Estimating portion sizes	11
Meal ingredients	6
Symptom definitions/ratings <i>Didn't know if I was really feeling bloated or legitimately full</i>	3
Burdensome	12
Writing down meal details	6
Time consuming	6
Carrying booklet and pen	6
Forgetting details <i>Would forget symptoms that happened two hours before</i> <i>Would forget ingredient's brand name by the time I got home</i>	7
Social embarrassment <i>People were asking me what I was doing</i> <i>Didn't want my doctor to see all the junk food I was eating</i>	4
Disruptive <i>Ruined the pleasure of eating</i> <i>Not caring to bring [the journal] out right there and then at a party or social event</i>	4
Discouraging <i>It was a constant reminder of my symptoms</i> <i>When eating bad, could not relax when eating</i>	3
What were you hoping to learn from tracking?	N=15
Symptom triggers	12
Baseline symptoms & eating habits	2
How to be "healthier" <i>Thought tracking would make me eat healthier</i>	2
Nothing	2
What did you learn from tracking?	N=17
Symptom triggers	14
Baseline symptoms & eating habits <i>I was surprised by how much prepared foods I eat</i> <i>Learned what my symptoms were really like</i>	10
What and how to track <i>Learned more about portion sizes</i> <i>Always thought I was a good label reader but saw surprising things in there</i>	6
Nothing	4
Safe foods	2
<i>Don't get symptoms with rice, bananas, and broth</i>	

journal for patients with IBS.¹⁰ Superior compliance rates, higher quality entries, and more efficient handling of data in electronic versus paper journals motivated us to build this app.²⁷⁻³⁰ The broader technology push to convert paper processes into apps also fueled our development. Although no direct comparison was made to our app, this study demonstrates that traditional paper journaling appears to be a feasible and usable option for some patients with IBS as a data collection tool.

Paper journaling has its benefits over apps. Firstly, it can be used by almost anybody. It does not exclude a person based on technical

savviness, smartphone models, Internet access, or data plan. There are also no language barriers as anybody capable of writing in any language can write down their food and symptoms. Secondly, paper journals are inexpensive, only requiring a piece of paper and pen. Third, every person can independently customize his/her journal based on his/her personal preferences and symptoms. These changes can occur whenever and however according to a patient's needs. Journal entries can also easily integrate annotations. Although app-based journaling is and will continue to be important, paper journaling for IBS patients is not yet obsolete and may be more appropriate for select patients.

In this study, all participants were able to complete all nine required days of food and symptom entries within a 15-day period with no detectable logging fatigability. Although most admitted to delaying meal entries at least once a day, they never completely forgot to log a meal. In addition, most of these delays were within 1 hour, an acceptable time range for food recall.¹² For symptom entries, most participants said they only forgot to log three entries over the entire study. Journaling was likely perceived as at least somewhat clinically useful for over half of our participants because it helped most identify at least one new symptom trigger. Similar to our group's prior feasibility study of an electronic food and GI symptom journal for patients with IBS, participants also found that journaling increased their self-awareness of current symptoms and eating patterns.¹⁰

Our completion and compliance rates were higher than other paper journal studies.^{6,7,28} Irritable bowel syndrome patients may be more motivated than patients in these former studies with other chronic medical conditions. Alternatively, our completion and compliance rates may be falsely elevated because our methods did not capture actual journal entry times. Therefore, falsified data from forward or backward filling could be present. Our methods also had no mechanisms to capture real-time symptoms and eating behaviors, so some entries could have been entirely missed. The lack of logging fatigue in this study was also unexpected.^{5,9} This could be partly explained by our recommended scheduling of journaling: 3 days "on" (logging) followed by 3 days "off" (not logging). In past dietary recall studies, logging fatigability became most apparent after more than four consecutive days.^{5,12} In addition, regular contact from research team members to review each set of journals and monetary compensation for participating in this study likely served as reminders and/or incentives for the continual high completion and compliance rates of our participants.

Although paper journaling appeared to be a feasible task for our study participants, the accuracy of the data cannot be guaranteed. Journaling inherently has some disadvantages as a data collection tool.^{7,11,28} Although participants did not frequently forget to log journal entries, almost half admitted to forgetting specific meal and/or symptom details. As seen in other dietary recall studies, half of the participants also admitted to changing their diet during the study to ease the burden of logging and to test triggers.¹¹ Therefore, the journal was unable to capture completely accurate baseline eating patterns. As outlined above, falsified data also could not be excluded.

Participants gave somewhat conflicting responses on the journal's feasibility and usability. Although most participants gave high feasibility and usability ratings on their evaluation responses, the majority

TABLE 3 Individual relationships between gastrointestinal symptoms and preceding meal nutrients using regression analyses

Participant	Symptom	Directionality	Nutrient	Correlated nutrients ^a	
2M	Abd Pain	Improving	Sorbitol*	None	
3M	Constipation	Worsening	Percent fat*	None	
4F	Diarrhea	Improving	Total protein*	Total calories, sodium	
5F	Diarrhea	Improving	Mannitol*	None	
		Worsening	Caffeine**	None	
6F	Bloating	Improving	Soluble dietary fiber*	Total fiber, insoluble fiber	
			Lactose*	None	
		Worsening	Starch*	Total calories, carbohydrates, sodium	
9F	Bloating	Improving	Fructose*	None	
10F	Abd Pain	Improving	Soluble fiber**	Total carbohydrates, total fiber	
			Total protein*	Total calories, total fat, sodium, potassium	
			Caffeine*	None	
		Worsening	Percent fat*	None	
			Lactose*	None	
			Starch**	None	
	Bloating	Improving	Mannitol*	None	
		Constipation	Improving	Mannitol**	None
				Sorbitol*	None
			Worsening	Fructose**	None
		Lactose*	None		
11F	Bloating	Improving	Percent fat*	None	
		Worsening	Total fat*	Total calories, total protein, sodium, starch none	
12F	Bloating	Improving	Total fat*	Total calories	
		Worsening	Insoluble fiber*	Magnesium, potassium, total fiber	
13F	Bloating	Improving	Soluble fiber*	Total fiber	
14F	Constipation	Worsening	Sodium*	Total protein	
15F	Bloating	Improving	Insoluble fiber*	Total protein, magnesium, potassium, total fiber	
		Worsening	Percent fat*	None	
	Diarrhea	Worsening	Caffeine*	None	
17F	Abd Pain	Improving	Soluble fiber*	Caffeine	
	Bloating	Improving	Soluble fiber*	Caffeine	
	Diarrhea	Worsening	Lactose*	None	
			Soluble fiber*	Caffeine	
1F, 7F, 8M, 16F	No significant associations found				

Abd: abdominal; F: female; M: male.

^aPrior to running regression analyses, a feature selection particular to each participant's diet was performed. Nutrients that had high pair-wise correlations (>0.75) with other nutrients were highlighted and the nutrient(s) with the highest average correlations of the highly correlated were removed and listed in this column.

* $P < .05$.

** $P < .001$.

reported at least one challenge with journaling during exit interviews (Table 2). Most found it difficult to assess certain meal specifics or to define symptoms, yet rated the journal as "very easy to use." Similarly, almost half rated that journaling was "not at all" burdensome on the evaluation, yet more than two thirds told us during the exit interviews that it was burdensome to log entries, especially meals. Perhaps

participants found these challenges relatively minor and not enough to affect the overall feasibility and usability of their paper journaling experience. Participants might have also felt that the expected benefits of journaling outweighed its burden.

As providers, we must also be wary of the potential distressing effect journaling could have on some patients with IBS. Over half of

participants reported feeling socially awkward using the journal and about a fourth of participants found it disruptive to their lives, either socially or with daily activities. This corresponded to a prior questionnaire study by Zia et al. investigating gastroenterology patient perspectives on mobile health applications where patients with IBS were more likely to find journaling in public to be embarrassing.³¹ A few participants even expressed that journaling discouraged them because it served as a “constant reminder” of their symptoms or made them “feel guilty” about their food choices. As we have seen in other patient populations, not every patient viewed “accountability” as a positive outcome of journaling.^{32,33}

Using a paper journal to log one’s meals and GI symptoms for 9 days over a 15-day period appeared to have no impact on GI symptoms, at least immediately postintervention. This differs from most other journaling studies, where the act of journaling has itself led to improvements in health measures for several medical problems.^{9,13,14} However, this finding is congruent to our group’s prior study on electronic journaling for patients with IBS.¹⁰ As previously explained in that study, there are no guaranteed effective treatment strategies for patients with IBS. Patients with IBS log to discover which treatment strategies are effective for their symptoms. On the other hand, patients with most other health conditions journal to adjust a known set of effective treatment strategies or objective outcomes (e.g., weight, blood pressure, blood glucose).

Similar to our prior electronic IBS journal study, our regression analyses were able to identify at least one possible relationship between GI symptoms and meal nutrients for most of our participants.¹⁰ Although these associations have not yet been validated, it could provide guidance on which elimination diets to first attempt for symptom reduction, as it did for patients in Kueper et al.’s past study.³⁴ If no significant associations were detected by our analyses, perhaps this was indicative that food was an unlikely trigger for that particular patient’s symptoms, at least with his/her present diet. In past focus groups and interview studies, patients with IBS felt overwhelmed and frustrated with the current trial-and-error process used to determine possible symptom triggers.^{10,35–37} They wanted more guidance during this process. These analyses were an attempt to fulfill this request, but need further development and validation.

4.1 | Study limitations

The results of this study might not accurately reflect the behaviors and perspectives of all IBS patients. Our participants were mostly young, highly educated White women with diarrhea predominant IBS of moderate disease severity.³⁸ This study also likely attracted participants who were more willing and able to journal. Prior to study enrollment, most participants had prior journaling experience. Most had already identified at least one trigger food and were following exclusionary diet(s). Despite our best efforts at separating current and past journaling experiences during our exit evaluation and interview, most participants did not reliably distinguish between these two experiences. These biases possibly inflated the feasibility, usability, and clinical utility of paper journaling found in this study. The duration of

journaling (9 days within a 15-day period) might have also affected these measures.

Secondly, our study instruments were not extensively tested for reliability and validity, especially our exit evaluation. However, we did address its face validity via expert and pilot participant reviews. Likewise, we modeled the symptom scale on an established and effective IBS self-management program.³⁹ We presumed that peak symptom severity and duration over an hour were the most important variables for most patients with IBS.

Thirdly, our analysis used to highlight associations between meal nutrients and GI symptoms had to make several assumptions and did not account for possible confounds (e.g., total calories, time of day, day of the week, stress levels, exercise levels, relaxation exercises, medications). Our group previously described some of these limitations when this analysis was first introduced.¹⁰ One assumption is that the sum of meal nutrients corresponds to the potential trigger for symptoms. Another assumption is that culprit foods trigger most GI symptoms within a 4-hour time window after eating. Although this timing is based on prior IBS patient reports on the timing of symptoms following trigger food ingestion, our analysis does not capture “delayed” or “cumulative” trigger food reactions.^{24–26} The potential mechanisms on how food triggers symptoms are still largely unknown but it is postulated that foods can alter the microbiome and/or result in inflammation of the intestinal wall, resulting in a more “delayed” or “cumulative” effect on IBS symptoms.⁴⁰ The authors want to emphasize that these analyses are still exploratory in nature, but at the very least, offer IBS patients a starting point in their search for their trigger foods. Future studies are needed to validate these associations.

5 | CONCLUSIONS

In this study, we confirmed the feasibility and usability of traditional paper food and GI symptom journals for patients with IBS. Similar results were observed for an electronic version of such a journal.¹⁰ Therefore, data collected from either paper or electronic journals is likely reliable and accurate. Neither type of journaling demonstrated significant impact on GI symptoms, at least immediately postintervention. Although more than half of participants found journaling at least somewhat clinically useful, they wanted more dietary guidance and feedback. The analysis presented in this study was our attempt to address this demand. Using the data collected from either a paper or electronic journal, our analyses were able to highlight potential relationships between meal nutrients and GI symptoms for most of our participants. Future studies will need to validate our analyses, but it is our hope that the associations from our analyses can be used to tailor exclusionary diets for our patients with IBS for reduced GI symptoms.

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CONFLICTS OF INTEREST

None.

AUTHOR CONTRIBUTION

EB, CC, MH, JK, SM, JMS, JZ conception and design; EB, CC, JZ acquisition of data; CC, JF, JS, JZ analysis and interpretation of data; JZ drafting of the manuscript; EB, CC, JF, MH, JK, SM, JS, JMS critical revision of the manuscript for important intellectual content; JS, JF, JZ statistical analysis; JZ obtaining funding; JZ administrative, technical, material support; MH, JK, SM supervision.

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