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RESEARCH ARTICLE
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ASSESSING THE FEASIBILITY AND DESIRABILITY OF A DIGITAL CARE PLAN FOR MANAGING IRRITABLE BOWEL SYNDROME IN INDIA

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Abstract
Digital health interventions (DHIs) are transforming chronic disease condition management by providing accessible, personalized, evidence-based interventions through digital platforms, such as smartphone applications. Irritable bowel syndrome (IBS), a chronic gastrointestinal disorder, affects 4.0%–7.9% of Indians. Given the short-term relief from conventional treatments, many individuals explore non-pharmacological interventions (NPIs) for desiring better management of their symptoms over the long term. This market research survey of 157 adults with IBS in India evaluated the feasibility and desirability of a 14-week digital care plan (DCP) incorporating NPIs, like a diet low in fermentable oligosaccharides, disaccharides, monosaccharides, and polyols (FODMAP), cognitive behavioral therapy (CBT), and physical wellness practices involving mind–body–breath (MBB) interventions. It assessed participant adherence and satisfaction rates at weeks 1, 7, and 14. Participants reported high satisfaction with dietary wellness components, particularly during the elimination (average rating 7.9/10) and reintroduction (9.2/10) diet phases, and they perceived

improvements in their symptoms and life quality over 14 weeks. Feasibility was reflected by participant adherence to DCP till week 7; however, it reduced by week 14. The findings highlight the potential of integrating such well-designed DCPs along with the current standard of care to enhance personalized care, satisfaction, and engagement for patients with IBS in India to help themselves take responsibility toward better outcomes.

Keywords: Digital care plan, irritable bowel syndrome, non-pharmacological interventions, participant adherence, participant satisfaction

Introduction

Digital health interventions (DHIs) present a unique opportunity to provide effective, sustainable, high-value care across various healthcare settings by integrating at multiple levels to promote proactive and coordinated care.[1] Mobile health, particularly through the use of smartphone applications, is an emerging area within digital healthcare.[1] With the rise of smartphone applications, there is a growing potential for personalizing evidence-based dietary and wellness interventions, thereby offering to improve adherence and optimize participant care.[2] In recent years, integrating DHIs into healthcare has gained recognition as a valuable tool in managing chronic diseases such as irritable bowel syndrome (IBS), diabetes, and other diseases.[3,4]

It is well established that IBS is a common, chronic, and relapsing functional gastrointestinal disorder,[5,6] characterized by recurrent abdominal pain, altered bowel habits (such as changes in frequency, stool consistency, and excretion patterns), bloating, abdominal distension, and flatulence.[7] Globally, it affects approximately 11% of adults,[8] whereas, in India, its prevalence ranges from 4.0% to 7.9%.[9] The standard of care for IBS, once diagnosed with recognized criteria, primarily involves pharmacological approaches, including promotility drugs, laxatives, antipsychotics, antispasmodics, and antidiarrheal drugs, which help patients during their short- to medium-term aggravation periods.[10] However, pharmacotherapies alone can provide only partial relief and may lead to drug intolerance due to side effects.[11] Moreover, IBS requires long-term management, prompting patients to seek non-pharmacological interventions (NPIs).[10] These include evidence-based NPIs, such as the National Institute for Health and Care Excellence (NICE) guideline-based diet, a diet low in fermentable oligosaccharides, disaccharides, monosaccharides, and polyols (FODMAP), gut-directed psychotherapy like cognitive behavioral therapy (CBT) and gut-directed hypnotherapy, physical wellness incorporating mind–body–breath (MBB) interventions, biofeedback therapy, along with some products like peppermint oil, probiotics, and others.[12-16]

With an advanced understanding of the disease and its nature of being managed, rather than treated, integrated care approaches incorporating DHIs are being more widely recommended.[3] Gaining insights into participant perspectives beforehand on their perceptions of desirability is essential for designing and implementing feasible interventions aligned with specific needs and challenges that would be easily adhered to help improve outcomes.[1] Despite the increasing popularity of DHIs, especially in the Indian scenario, there is limited evidence on the usage and understanding of DHIs for chronic conditions like IBS. Hence, this survey explores the market potential of a DCP specifically designed for IBS management in India, assessing its feasibility, desirability, and satisfaction among participants.

Methods

Survey Details

This survey elicited responses from participants with IBS anonymously, who were part of a 14-week DCP for IBS management, developed by Dr. Reddy's Laboratories. The DCP was deployed through a smartphone application, targeting adults (≥18 years) with IBS in India, who had access to internet connectivity. The survey spanned 14 weeks (week 1: selection and initial assessment, and week 14: data and feedback collection). The participants were evaluated at the start of the survey (week 1), mid-survey (week 7), and at the end of the survey period (week 14).

As it is a market research survey it involved the use of anonymized participant data without disclosing any sensitive personal information. Ethical committee review was not applicable. The survey adhered to requisite guidelines, and participant confidentiality was strictly maintained throughout.

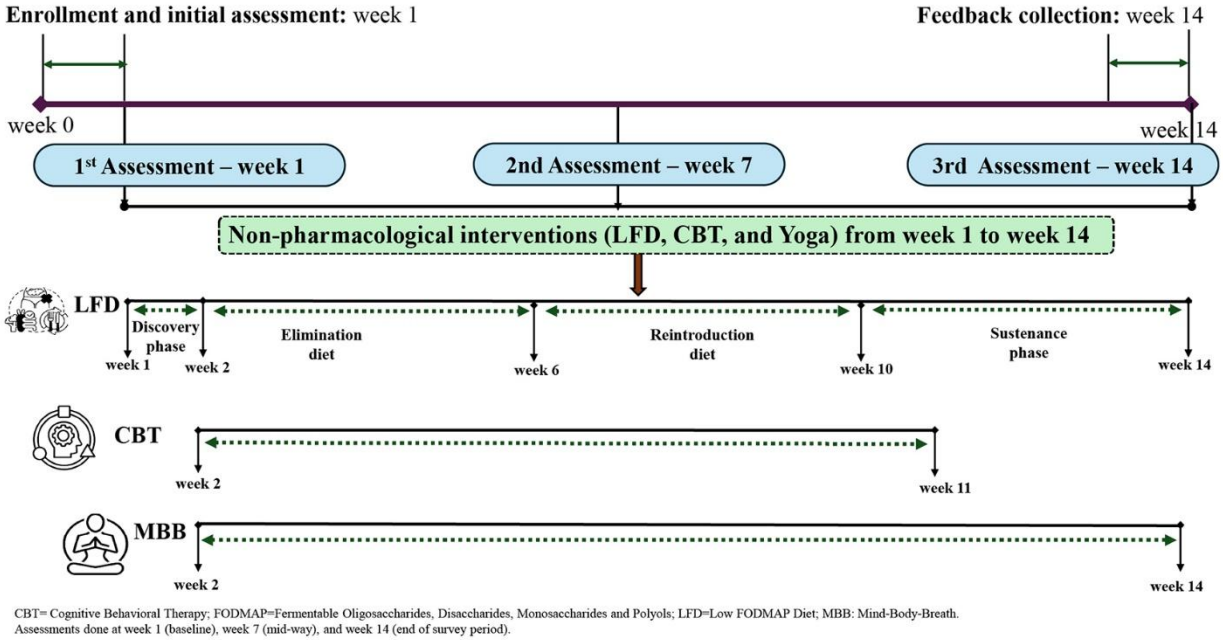
Assessments

Feasibility and desirability were measured using a self-reported questionnaire, scored on a scale of 0 to 10, with 0 being the least and 10 being the maximum willingness among participants. The questionnaire focused on comfort in lifestyle discussion, self-awareness, daily relaxation techniques, confidence in the program, and satisfaction with dietary components. Additionally, elicitation of the participant's feeling of symptom reduction was assessed using a pre-validated tool – Irritable Bowel Syndrome Severity Scoring System (IBS-SSS; copyright of Rome Foundation, USA).[17] It consists of five key domains (abdominal pain intensity, abdominal pain frequency, abdominal distension/bloating, bowel habit dissatisfaction, and impact on quality of life, each scored on a visual analog scale (VAS) from 0 to 100, resulting in a total possible score ranging from 0 to 500.

Data Collection

Data were collected on participant characteristics, satisfaction, and adherence to the DCP through the application anonymously. It evaluated the feasibility, desirability, and satisfaction based on feedback from the questionnaires during the 14-week DCP. The NPIs included in the DCP, namely low-FODMAP diet, CBT, and MBB interventions, were structured into four distinct phases (**Figure 1**). Regular telephonic calls were scheduled with trained licensed nutritionists and behavioral health professionals to provide personalized consultations and monitor participant progress. The survey was executed by our listed and approved market research partner agency. All data were securely stored and accessed only by authorized personnel. Statistical analysis was performed using SPSS (IBM SPSS Statistics for Windows, Version 27.0. Armonk, NY: IBM Corp. Released 2020). Appropriate statistical tests were applied, and statistical significance was set at $p<0.05$.

Figure 1. Participant feedback collection time points during the DCP journey



CBT= Cognitive Behavioral Therapy; FODMAP=Fermentable Oligosaccharides, Disaccharides, Monosaccharides and Polyols; LFD=Low FODMAP Diet; MBB: Mind-Body-Breath. Assessments done at week 1 (baseline), week 7 (mid-way), and week 14 (end of survey period).

Results

Participant Characteristics

A total of 200 individuals with IBS were approached, among whom 157 participants enrolled in this survey. They were majorly from Mumbai, Ahmedabad, Delhi, Lucknow, and Jaipur. Of them, 39.1%

were men, 60.9% were women (**Figure 2A**), with 82.1% being married. The mean ± SD age was 38.18 ± 8.72 years, with the majority (60.9%) between the ages of 21 and 40 years. Approximately 47.4% of participants reported experiencing IBS symptoms for more than 2–5 years. The predominant subtype was IBS with constipation (IBS-C), affecting 62.2% of the survey population (**Table 1**).

Table 1. Participant characteristics

Demographics	Participants[a] N (%)
Age[b]	
21–40 years	95 (60.9)
41–60 years	61 (39.1)
Gender	
Male	61 (39.1)
Female	95 (60.9)
Marital status	
Married	128 (82.1)
Unmarried	27 (17.3)
Widow	1 (0.6)
City	
Ahmedabad	26 (16.7)
Bengaluru	7 (4.5)
Bikaner	1 (0.6)
Delhi	21 (13.5)
Hyderabad	7 (4.5)
Indore	8 (5.1)
Jaipur	16 (10.3)
Kolkata	7 (4.5)
Lucknow	18 (11.5)
Mumbai	45 (28.8)
Duration of IBS[c]	
≤1 year	24 (15.8)
>1–2 years	34 (22.4)
>2–5 years	72 (47.4)
>5–10 years	13 (8.6)
>10 years	6 (4.0)
Since childhood	3 (2.0)
IBS subtype	
C	97 (62.2)
D	24 (15.4)
M	35 (22.4)

Data are expressed as numbers (percentages).
[a]The total number of participants included was 157. Data were missing for one participant, resulting in a final sample size of 156.
[b]Age (mean [SD]): 38.18 (8.72) years.
[c]The sample size for the diagnosed duration of IBS was 152.
C, constipation; D, diarrhea; IBS, irritable bowel syndrome; M, mixed bowel; N, number of participants.

Consumer Insights on DCP

Satisfaction and Engagement

Participant feedback on the DCP gathered through a questionnaire, reflected their satisfaction with the components of the NPIs. Participants reported being highly comfortable with lifestyle discussions (average rating: 8.5/10) and expressed confidence in the daily relaxation techniques practiced (average rating: 6.9/10). They showed initial confidence in the 14-week IBS program via DCP

(average rating: 8.2/10), a smooth transition into the new diet regime (average rating: 8.9/10), high satisfaction with the elimination diet phase (average rating: 7.9/10), and a strong commitment to continue the program during the reintroduction phase (average rating: 9.2/10). Dietary changes were well-received, with consistently high ratings for the feasibility of the elimination phase (**Table 2**). The participants perceived improvements in their symptoms and life quality over 14 weeks. This perception is based on noting significant reductions (p=0.001) in mean ± SD IBS-SSS scores for abdominal pain (week 1, 68.0 ± 23.1 to week 14, 9.8 ± 14.0), abdominal distension (week 1, 63.7 ± 26.2 to week 14, 12.4 ± 15.0), bowel habits (week 1, 64.7 ± 23.5 to week 14, 23.6 ± 25.4), and life quality (week 1, 66.8 ± 2.36 to week 14, 24.9 ± 25.1), which added to the overall satisfaction of the participants (**Supplementary Tables S1 and S2**).

Table 2. Participant feedback after NPI over 14-weeks

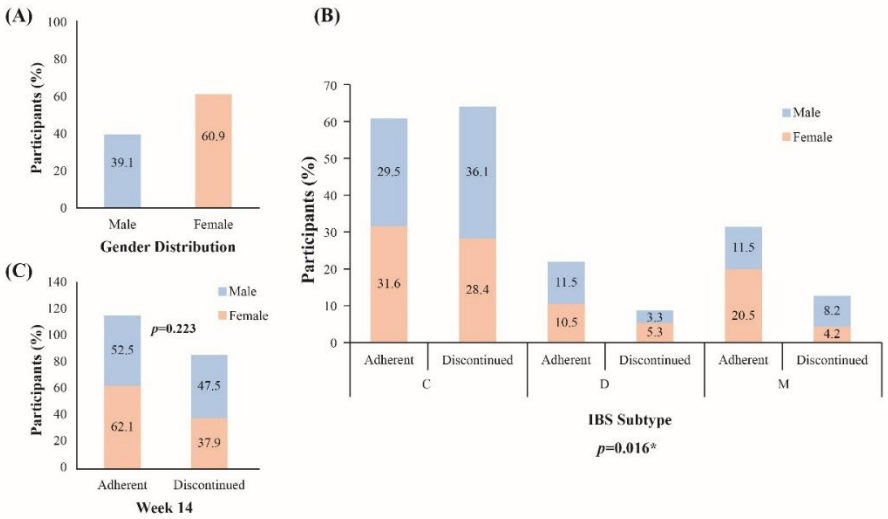
Considerations	N	Mean (SD)
Wellness		
Comfort discussing daily lifestyle	48	8.5 (1.2)
Self-awareness relevance rating	29	9.1 (1.0)
Incorporation of daily relaxation techniques	43	7.3 (2.1)
Confidence in practicing relaxation techniques	24	6.9 (1.7)
Confidence in trying out relaxation methods	7	7.1 (2.7)
Differentiating thoughts and emotions	33	6.6 (2.1)
Confidence in practicing relaxation techniques	10	6.2 (0.9)
Diet		
Confidence in the 14-week IBS program	64	8.2 (1.9)
The appeal of logging food	29	9.1 (0.7)
Feasibility of the elimination phase	7	8.1 (0.9)
Experience with the elimination diet	54	7.9 (1.4)
Confidence in new diet resolving hurdles	13	8.3 (0.9)
Smooth transition into new diet	13	8.9 (0.9)
Satisfaction with the elimination phase	41	8.0 (1.4)
Confidence in maintaining a food journal	6	8.3 (1.2)
Smooth transition into new diet	10	8.2 (0.9)
Commitment to the reintroduction phase	10	9.2 (0.8)

Data are expressed as mean (SD).
DCP, digital care plan; IBS, irritable bowel syndrome; N, number of participants;
NPI, non-pharmacological intervention; SD, standard deviation.

Adherence Rates and Consumer Retention

Participants showed initial interest and adherence to the DCP till week 7; however, there was a downward trend at week 14. Overall, a statistically significant difference in adherence rates was observed among IBS subtypes (p=0.016). Participants with IBS-C showed higher adherence to scheduled appointments (61.1%), compared to those having IBS with diarrhea (IBS-D, 22%) and IBS with mixed bowel (IBS-M, 31.5%) (**Figure 2B**). Although gender did not significantly affect treatment adherence, women showed marginally better adherence to follow-up than men (62.1% *vs.* 52.5%, p=0.223). The attrition rate (those who discontinued) at week 14 among participants was 47.5% for men and 37.9% for women, with only 91 participants (35.2% men and 64.8% women) completing the survey (**Figure 2C**).

Figure 2. Participant engagement with DCP



(A) Gender distribution of participants enrolled, (B) Adherence to DCP by IBS subtype, and (C) Adherence to DCP denoting gender distribution. The attrition rate was high by the end of the survey period. Females were more adherent to the DCP. Participants with IBS showed adherence, particularly significant for IBS subtypes (p=0.016, chi-square test).
*Indicates statistically significant data with p<0.05.
C, constipation; D, diarrhea; DCP, digital care plan; IBS, irritable bowel syndrome; M, mixed bowel.

Discussion

DHIs, including DCPs, are transforming chronic disease management by providing personalized, real-time monitoring, and tailored treatments.[18,19] In this survey, the overall encouraging feedback received from participants in India on the usefulness of DCP in IBS management highlights the potential of DHIs in enhancing participant participation, engagement, and adherence, potentially leading to better health outcomes in the Indian market. Our DCP was structured around evidence-based NPIs, including the low-FODMAP diet, CBT, and physical wellness through MBB interventions.[10,14,20] In this survey, the participants were receptive to the DCP, particularly because it offered personalized and comprehensive care. They appreciated the constant access to evidence-based resources and the ability to track progress. Moreover, significant participant satisfaction, along with improvements in symptoms and life quality further validates the benefits of digital technologies and highlights their promise in integrating them into chronic disease management.

The findings from this survey further substantiate the DCP's potential to enhance care, increase retention, and establish a strong foothold toward the growth of the digital health sector in India and highlight a significant market potential for expanding DHIs tailored to chronic conditions requiring long-term management in India. The participants perceived improvements in their symptoms like abdominal pain, bloating, bowel habits, and life quality in their IBS-SSS-based scores over 14 weeks. Consistent with this survey, another 9-week survey showed that a personalized, machine learning-based digital elimination diet program resulted in high engagement, satisfaction, and adherence among most individuals with IBS.[2] Evidence suggests that IBS management using a digital platform to deliver NPI offers a step forward, without recurrent visits to clinics, thereby minimizing challenges of accessibility, cost, and time constraints.[19]

In our survey, participant feedback indicated high satisfaction with the DCP's participant-friendly interface and comprehensive features, but the attrition rate was notably higher, particularly toward the end of the program probably due to various reasons including early satisfaction rates reported. Consistent with this, a survey on diabetes management has shown initial high participant engagement but faced challenges with long-term adherence.[21] Another survey on DCPs targeting other chronic gastrointestinal conditions, such as inflammatory bowel disease, has reported high satisfaction with app-based care but also faces the challenge of long-term participant retention.[22] This could be due to constraints in digital literacy, where participants may not be competent with the evolving technology, which can hinder sustained participant engagement.[1]

One of the key strengths of this survey is offering the use of such a desirable and feasible digital platform to provide personalized care with NPIs to patients with IBS, allowing for real-time data collection and continuous remote patient engagement, which are integral in managing such chronic conditions over the long term. However, despite promising findings, this survey has a few limitations, such as a small sample size, limited to smartphone users, needing English literacy, especially in the Indian context, and a higher attrition rate toward the end of the program.

Developing a DCP specifically catering to the needs of Indian participants with IBS could appeal to a large section of the population suffering from IBS, especially as more participants seek multiple solutions to manage their condition, indicating a greater market potential in India.[23,24] Thus, strategic collaborations with healthcare providers, keeping gastroenterologists at the center of this integrated care, aided by digital consultations with nutritionists and mental health professionals, with evidence-based NPIs could further enhance the credibility and reach of DCPs. Besides, integrating DCPs with existing healthcare infrastructure, such as hospitals and clinics, would create comprehensive care solutions,[1] facilitating seamless transitions between in-person care and digital consultations, thereby improving continuity of care.[19]

Future initiatives should prioritize customizing the DCP to offer more evidence-based NPIs, create multilingual smartphone application interfaces with region-specific content, and integrate AI into telehealth services to broaden outreach and improve participant experience further. Co-designing the DCP with participants and healthcare providers from the inception will be critical to optimizing digital engagement strategies and ensuring long-term sustainability in the Indian market. Participant-centered approaches can offer a scalable solution to chronic disease management, positioning digital health as a key component of personalized healthcare in future healthcare systems. A well-optimized, participant-friendly digital strategy can lead to a more resilient and adaptable healthcare system, proficient in meeting the evolving needs of participants and providers alike.

Conclusion

This survey provides compelling evidence that a 14-week DCP with NPIs for managing IBS was well-received by participants in India. As digital health continues to evolve, it holds promise for transforming IBS management by delivering customized, accessible, and participant-centered care effectively. These market research findings offer preliminary evidence of market implications, toward using an appropriate DCP to augment conventional care to manage IBS comprehensively.

Supplementary Information

Provided as a Supplementary File containing Tables S1 and S2.

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Authorship Credit

The concept and design of the study and acquisition, analysis, and interpretation of data were accomplished by J.B., N.N., A.K., N.D., J.S., and S.K. Drafting the article or revising it critically for intellectual content was done by S.A. and S.N.C. The final approval of the manuscript version to be published was provided by B.P.K. and S.N.C.

Abbreviations

CBT	Cognitive behavioral therapy
DCP	Digital care plan
DHI	Digital health intervention

FODMAP	Fermentable oligosaccharides, disaccharides, monosaccharides, and polyols
IBS	Irritable bowel syndrome
IBS-C	IBS with constipation
IBS-D	IBS with diarrhea
IBS-M	IBS with mixed bowel
IBS-SSS	Irritable bowel syndrome severity scoring system
MBB	Mind–body–breath
NPI	Non-pharmacological intervention
VAS	Visual analog scale

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Supplementary File

Table S1. Changes in IBS-SSS score for NPI across 14-weeks

Parameters	**Week 1 Mean (SD)**	**Week 7 Mean (SD)**	**Week 14 Mean (SD)**	***p*-Value**
Number of participants	155[a]	114[b]	91[c]	------
IBS-SSS score	319.7 (83.2)	137.4 (81.6)	81.7 (64.0)	0.001*
Symptoms experienced				
Abdominal pain	68.0 (23.1)	21.8 (23.2)	9.8 (14.0)	0.001*
Frequency of abdominal pain every 10 days (days)	56.4 (24.4)	17.2 (19.0)	10.9 (15.3)	0.001*
Abdominal distension/tightness (bloating, swollen, or tight tummy)	63.7 (26.2)	23.4 (22.3)	12.4 (15.0)	0.001*
Bowel habit satisfaction	64.7 (23.5)	32.5 (23.8)	23.6 (25.4)	0.001*
Impact on life quality	66.8 (2.36)	42.5 (27.0)	24.9 (25.1)	0.001*
IBS severity[d]				
Severe	86 (55.1)	3 (2.6)	0	0.001*
Moderate	58 (37.2)	33 (28.9)	13 (14.3)	
Mild	11 (7.7)	50 (43.9)	29 (31.9)	
Cured	0	28 (24.6)	49 (53.8)	

Data are expressed as mean (standard deviation). Friedman's test was performed for continuous variables and chi-square test for categorical variables.

[a]The total number of included participants was 157. However, data were missing for two participants, resulting in a final sample size of 155.

[b]Due to participants dropping out from week 1 to week 7, the sample size reduced from 155 to 114.

[c]Due to participants dropping out from week 7 to week 14, the sample size reduced from 114 to 91.

[d]The table summarizes the changes in IBS severity over three time points (using IBS-SSS: mild [75–174]; moderate [175–299]; severe [300–500]) at week 1, week 7, and week 14, with an overall *p*-value of 0.001 from a chi-square test.

IBS, irritable bowel syndrome; NPIs, non-pharmacological interventions; SD, standard deviation; SSS, severity scoring system.

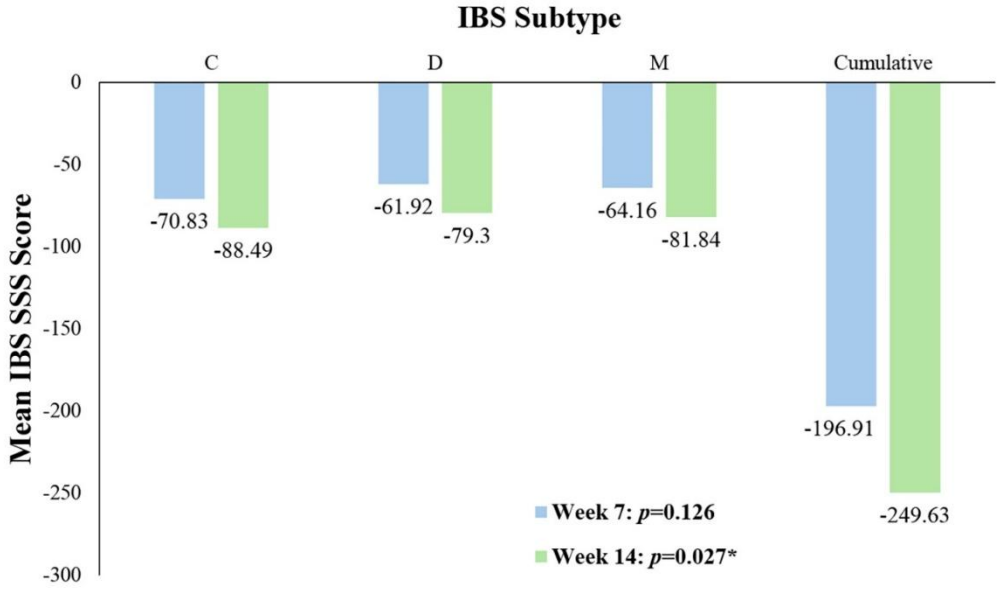
Table S2. Overall symptom improvement perceived by participants

Parameters	**Number of Participants**				**Z Score**
	Total	**Reduction (Mean Rank)**	**Increase (Mean Rank)**	**No Change**	
IBS-SSS over time					
Week 7–week 1*	113	109 (58.62)	4 (12.75)	0	−9.082
Week 14–week 7*	88	64 (46.15)	21 (33.40)	3	−4.937
Week 14–week 1*	91	91 (46.00)	0 (0.00)	0	−8.286
Frequency of abdominal pain over time					
Week 7–week 1*	113	100 (54.42)	4 (4.50)	9	−8.812
Week 14–week 7*	88	45 (30.86)	15 (29.43)	28	−3.525
Week 14–week 1*	91	89 (45.00)	0 (0.00)	2	−8.211
Severity of abdominal pain over time					
Week 7–week 1*	113	99 (59.64)	10 (9.05)	4	−8.809
Week 14–week 7*	88	43 (33.76)	16 (19.91)	29	−4.315

Week 14–week 1*	91	89 (45.00)	0 (0.00)	2	−8.223
Abdominal distension/tightness over time					
Week 7–week 1*	113	102 (53.91)	3 (22.17)	8	−8.704
Week 14–week 7*	88	47 (37.15)	19 (24.47)	22	−4.122
Week 14–week 1*	91	88 (46.31)	2 (9.75)	1	−8.184
Bowel habit satisfaction					
Week 7–week 1*	113	91 (57.84)	16 (32.19)	6	−7.394
Week 14–week 7*	88	47 (37.37)	22 (29.93)	19	−3.309
Week 14–week 1*	91	79 (48.45)	10 (17.75)	2	−7.481
Life quality					
Week 7–week 1*	113	85 (58.32)	24 (43.23)	4	−5.944
Week 14–week 7*	88	57 (44.71)	22 (27.80)	9	−4.757
Week 14–week 1*	91	79 (46.29)	7 (12.00)	5	−7.708

The paired-sample Wilcoxon test was performed.
*Indicates statistically significant data with p=0.001.
IBS-SSS, Irritable Bowel Syndrome Severity Scoring System.

Figure S1. IBS-SSS score reduction by IBS subtype



Participants with IBS subtype C had a significantly higher reduction of IBS-SSS scores by week 14 compared to week 7 (p=0.027, chi-square test). Overall, there was a significant reduction in scores at week 14 among all participants.

*Indicates statistically significant data with p<0.05.

C, constipation; D, diarrhea; IBS, irritable bowel syndrome; M, mixed bowel; SSS, severity scoring system.