Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Abdominal Bloating and Distension: A prospective study evaluating the clinical utility of the Mayo Bloating Questionnaire

Paul M. Travers

travers.paul@mayo.edu

Mayo Clinic

Induja Nimma

Mayo Clinic

Lilly Stephens

Mayo Clinic

David J. Cangemi

Mayo Clinic

Brian E. Lacy

Mayo Clinic

Research Article

Keywords: Small Intestinal Bacterial Overgrowth (SIBO), breath testing, bloating, lactose, fructose, lactulose

Posted Date: November 26th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-11627500/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: No competing interests reported.

Abstract

Introduction

Our aim was to objectively quantify symptoms of abdominal bloating and distension using a novel tool to aid in severity stratification, characterize the impact of symptoms on quality of life, and assess clinical improvement.

Methods

229 patients referred for breath testing for evaluation of abdominal bloating and/or distension were enrolled over a 12-month period. All included patients completed a pre-breath test questionnaire. Patients who tested positive for small intestinal bacterial overgrowth (SIBO) completed the same questionnaire within 14 days of completing treatment, which was determined by their primary gastroenterologist. Data was analyzed using standard methods.

Results

Pre-breath test questionnaire scores were not significantly different among patients that tested positive or negative with lactulose, lactose, or fructose breath tests. Patients with a reported history of gastroparesis (n = 25, p = 0.0006), functional dyspepsia (n = 11, p = 0.0099) and fructose intolerance (n = 4, p = 0.0396) scored higher on pre-breath test bloating questionnaires than their history-negative counterparts. Patients who tested positive for SIBO had significantly decreased mean questionnaire scores after completing treatment (p = 1.01e-5). Questionnaire completion was high at 97%.

Conclusions

This study demonstrates that the Mayo Bloating Questionnaire may be used to assess treatment response in patients with abdominal bloating and/or distension due to SIBO. The questionnaire was easy to use and reliable, making it a viable tool for both clinical practice and research.

Key Points

The Mayo Bloating Questionnaire (MBQ) is easy to use and reliable for quantifying bloating/distension severity in clinical practice.

Pre-test MBQ scores did not distinguish patients with positive vs negative lactulose, lactose, or fructose breath tests.

Among SIBO-positive patients, MBQ scores decreased by ~ 43% after antibiotic treatment, supporting its utility for tracking treatment response.

Introduction

Abdominal bloating and distension are two highly prevalent gastrointestinal symptoms that develop due to a variety of abnormalities including food intolerances (e.g., lactose, fructose), abnormal gut microbiota, visceral hypersensitivity, and delayed intestinal transit (1). Abdominal bloating is defined as a subjective sensation of fullness or gas trapping while abdominal distension is defined as an objective increase in abdominal girth (2). Bloating and distension are commonly reported by many patients but frequently co-exist with disorders of gut-brain interaction (DGBI), such as irritable bowel syndrome (IBS) and functional dyspepsia (FD) (1, 2). One large U.S. population survey study found that up to 30% of respondents experienced abdominal bloating and/or distension in the previous week (3). Chronic or persistent symptoms of abdominal bloating can negatively affect patients' quality of life and frequently lead to gastroenterology consultation, particularly in patients with DGBI, such as IBS (4). While patients may report abdominal bloating or distension, they are not mutually exclusive – about 50% of patients with bloating also report abdominal distension (5, 6).

The underlying pathophysiologic mechanisms of abdominal bloating and distension are varied and incompletely understood, but generally involve increased intraluminal contents, dysbiosis, and/or visceral hypersensitivity (1, 2, 5, 7, 8). Small intestinal bacterial overgrowth (SIBO) is one of the more commonly implicated causes of abdominal bloating and distension; however, its true prevalence in this population is difficult to glean due to lack of consensus regarding diagnostic testing (9, 10). While small bowel aspirates are considered, by many, to be the gold standard for the diagnosis of SIBO, both glucose and lactulose breath tests are commonly used due to the safety profile and availability (10). Additionally, in a recent study comparing duodenal aspirates to lactulose breath tests, duodenal aspirates were associated with a contamination rate approaching 20%, further highlighting the limitations of testing for SIBO (11). Following the diagnosis of SIBO, treatment typically involves the use of antibiotics with the goal of eradicating SIBO and improving symptoms, with patient-reported symptoms often used as the barometer of treatment success or failure. Despite treatment, however, a significant proportion of patients remain symptomatic. The degree of symptom improvement, or lack thereof, is difficult to quantify due to the subjective and nonspecific nature of bloating and distension symptoms.

In this prospective study we aimed to objectively quantify symptoms of abdominal bloating and distension using a novel tool to aid in severity stratification, characterize the impact on quality of life, and assess symptom improvement after therapy. The Mayo Bloating Questionnaire (MBQ) has previously been proven to be easy to use, valid, and reliable; however, it has not been used in a prospective study (12). Thus, we aimed to test the MBQ in clinical practice to determine its correlation with positive breath test results and evaluate its utility as a tool to assess treatment outcomes in SIBO positive patients with abdominal bloating and/or distension.

Methods

This was a prospective study of patients referred to the motility lab at Mayo Clinic Florida between July 2022 and July 2023 for symptoms of bloating and/or abdominal distension. All patients included completed the Mayo Bloating Questionnaire (MBQ) prior to breath testing (lactulose, fructose, and/or lactose intolerance tests). Some patients underwent multiple breath tests. If multiple breath tests were completed, they were done on different days. Patients who tested positive for SIBO completed the MBQ a second time following SIBO treatment (specific treatment was determined by the primary gastroenterologist). All patients were over 18 years of age. Patients who were unable to read/understand English were excluded.

The study protocol was approved by the Mayo Clinic Institutional Review Board. A waiver of informed consent was obtained given the minimal risk associated with the questionnaire study format.

The MBQ is a 45-item survey with individual items scored on a 5-point Likert scale ranging from 0-100 (12). The maximum possible score is 1300 points. The difference between average pre- and average post-breath test total MBQ score was the primary outcome of interest. Collected variables included demographics (age, sex, race, BMI), comorbidities including IBS, FD, gastroesophageal reflux disease (GERD), gastroparesis, celiac disease, and prior diagnoses of lactose or fructose intolerance.

The results of breath tests were collected after patients completed the pre-test MBQ. Patients identified as positive for SIBO were contacted via telephone within 14 days of completion of antibiotic therapy (as determined by their primary gastroenterologist) for the treatment of SIBO to complete the post-treatment MBQ. The post-treatment MBQ was completed via telephone. The date of completion of antibiotic therapy was determined via chart review.

The Anderson-Darling Test was used to evaluate departures from normality. T-tests were used to compare MBQ means between groups. All tests performed were 2-sided, and statistical significance was defined as a P value < 0.05. BlueSky Statistics software v 7.10 (Blue Sky Statistics LLC) was used to perform the statistical analysis. Statistical analysis was completed on an intention to treat basis.

Results

Baseline characteristics are summarized in Table 1. 229 patients were evaluated for study inclusion; 216 patients were available for analysis. Thirteen patients were excluded as they did not complete the pre-breath test questionnaire (5.8%). Of the 216 patients included, most were White (88.9%). The most common self-reported comorbidities were IBS (59.4%), GERD (42.4%), and lactose intolerance (17.5%). Mid-abdominal symptoms were the most common (34.1%), followed by diffuse/difficult to localize symptoms (27.6%) (Fig. 1). Most patients had symptoms that interfered with meals (59.3%) prompting a vast majority to make dietary changes (79.6%). Most patients' symptoms lead to absences at social events (60.7%) while a minority had symptoms severe enough to cause absences at work/school (23.8%).

Table 1
Baseline characteristics

Baseline characteristics median (IQR) or fraction (%)	
	All patients N = 229
Age	52.3 (41–65)
Male gender	176/229 (76.9)
BMI	25.2 (21.3–29.3)
Race	
White	202/229 (88.9)
Black	11/229 (4.8)
Asian	8/229 (3.5)
Other	8/229 (3.5)
Past medical history:	
Irritable bowel syndrome	136/229 (59.4)
Constipation-predominant	21/84 (25)
Diarrhea-predominant	29/84 (34.5)
Mixed	34/84 (40.5)
Gastroesophageal reflux disease	97/229 (42.4)
Gastroparesis	25/229 (10.9)
Small intestinal bacterial overgrowth	35/229 (15.3)
Dyspepsia	11/229 (4.8)
Celiac disease	10/229 (4.4)
Lactose intolerance	40/229 (17.5)
Fructose malabsorption	4/229 (1.7)

186 total patients underwent lactulose breath testing, with 23 patients (12.4%) testing positive. 71 total patients underwent lactase deficiency testing with 22 patients (30.9%) testing positive and 60 patients underwent fructose intolerance testing with 16 patients (26.7%) testing positive; note that the total number of patients is greater than 216 as some patients had more than one breath test. Breath tests were completed on different days.

Pre-breath test MBQ scores were not significantly different among patients that tested positive or negative with lactulose, lactose, or fructose breath tests (Table 2). Patients with reported histories of gastroparesis (n = 25, p = 0.0006), FD (n = 11, p = 0.0099) and fructose intolerance (n = 4, p = 0.0396) scored higher on pre-breath test bloating questionnaires than their history-negative counterparts. A history of IBS (n = 93) and/or a prior history of SIBO (n = 35) did not correlate with any change in pre-breath test questionnaire scores. Of the 23 patients that tested positive for SIBO, 17 completed both the pre-MBQ, SIBO treatment, and post-MBQ. Patients who tested positive for SIBO had significantly decreased mean questionnaire scores after treatment (p = 1.01e-5). The average MBQ score decreased by 43% after treatment. Of note, 14 of the 17 patients that completed both the pre-MBQ, SIBO treatment, and post-MBQ were treated with Rifaximin for SIBO (82.4%). The remaining three used alternative antibiotics (azithromycin, neomycin, and augmentin) due to lack of insurance coverage for Rifaximin. Interestingly, when the alternative antibiotic group was analyzed in a subgroup analysis, they did not have a statistically significant decrease in MBQ score following treatment (t = 1.7239, p = 0.16).

Table 2
Mean difference of MBQ scores based on breath test results

Breath Test Type	Breath Test Outcome	Patient Number	Mean MBQ Score	Mean difference	p-value
Lactulose	Negative	163	570.98	43.78	0.365
	Positive	25	527.2		
Lactase	Negative	49	507.04	11.13	0.851
	Positive	22	495.91		
Fructose	Negative	44	480.57	70.83	0.128
	Positive	16	590		

Discussion

Our study has several limitations. Because the cohort consisted solely of patients referred for breath testing during the evaluation of abdominal bloating and distension, the results may not generalize to the broader population of individuals with these common symptoms. The sample was also predominantly male and White, underscoring the need for validation of the MBQ in more diverse patient groups. In addition, not all potentially relevant comorbidities or contributing factors (e.g., diet, pelvic floor dysfunction, medications) were systematically assessed. As with all survey-based studies, the possibility of post-treatment response bias exists, and placebo-controlled designs would better address this. Post-treatment breath testing was not protocolized, limiting our ability to correlate MBQ improvement with physiologic normalization; thus, our findings should be viewed as hypothesis-generating, with repeat breath testing incorporated into future studies. Finally, approximately 20% of participants were lost to follow-up, although intention-to-treat analyses help mitigate this concern.

Despite these limitations, our results demonstrate that the MBQ performs well as a practical, quantitative tool for assessing symptom severity in patients undergoing evaluation for bloating and distension. Although pre-treatment MBQ scores did not distinguish between positive and negative breath tests, the significant reduction in MBQ scores among SIBO-positive patients following antibiotic treatment highlights the questionnaire's value for tracking therapeutic response. Given the high prevalence of bloating and the limitations of subjective clinician assessment, incorporating a brief, validated tool such as the MBQ into routine practice may improve symptom monitoring, facilitate standardized communication, and support more objective treatment evaluation

Conclusions

In this prospective study of patients undergoing diagnostic evaluation for abdominal bloating and distension, the Mayo Bloating Questionnaire proved to be a practical and effective tool for quantifying symptom severity and monitoring clinical response. We had previously shown the MBQ to be valid, reliable, and easy to use, but it had not yet been used in a clinical setting. Although baseline MBQ scores did not differentiate individuals with positive versus negative breath tests, patients with SIBO demonstrated a significant reduction in MBQ scores following antibiotic therapy, supporting the questionnaire's utility for assessing treatment-related change. Given the high prevalence of bloating and the limitations of relying solely on subjective clinician impressions, incorporating a brief, validated instrument such as the MBQ into routine clinical practice may enhance symptom tracking, improve communication, and provide a more standardized framework for evaluating therapeutic effectiveness. Further studies in more diverse populations and with protocolized repeat breath testing will be important to confirm these findings and to refine the role of the MBQ in the broader management of bloating and distension.

Declarations

Funding:

None.

Conflict of Interest: All authors declare no conflicts related to this study.

Ethics approval: Approved by the Mayo Clinic Institutional Review Board; waiver of informed consent granted given minimal risk.

Patient consent: Not required due to IRB waiver for this minimal-risk questionnaire study.

Data availability: De-identified data underlying the findings are available from the corresponding author upon reasonable request.

Author Contribution

P.T.: conceptualization, methodology, data curation, formal analysis, writing—original draft, review & editing.I.N.: data curation, writing—review & editing.L.S.: data curation.D.C.: supervision, writing—review & editing.B.L.: conceptualization, methodology, supervision, writing—review & editing.

References

1. Lacy BE, Cangemi D, Vazquez-Roque M. Management of chronic abdominal distension and bloating. Clin Gastroenterol Hepatol 2021; 19. 219–231.e1
2. Lacy B, Mearin F, Chang L, et al. Bowel disorders. Gastroenterology 2016;150:1393–1407.
3. Almario CV, Ballal ML, Chey WD, et al. Burden of gastrointestinal symptoms in the United States: Results of a nationally representative survey of over 71,000 Americans. Am J Gastroenterol 2018; 113:1701–1710.
4. Ringel Y, Williams RE, Kalilani L, et al. Prevalence, characteristics, and impact of bloating symptoms in patients with irritable bowel syndrome. Clin Gastroenterol Hepatol 2009; 7:68–72.
5. Azpiroz F, Malagelada JR. Abdominal bloating. Gastroenterology 2005;129:1060–1078.
6. Serra J, Azpiroz F, Malagelada JR. Impaired transit and tolerance of intestinal gas in the irritable bowel syndrome. Gut 2001;48:14–19.
7. Serra J, Azpiroz F, Malagelada JR. Modulation of gut perception in humans by spatial summation phenomena. J Physiol 1998; 506:579–587.
8. Drossman D. Functional gastrointestinal disorders: history, pathophysiology, clinical features, and Rome IV. Gastroenterology 2016; 150:1262–1279.
9. Rezaie A, Buresi M, Lembo A, et al. Hydrogen and methane-based breath testing in gastrointestinal disorders: The North American consensus. Am J Gastroenterol 2017; 112:775–784.
10. Choung RS, Ruff KC, Malhotra A, et al. Clinical predictors of small intestinal bacterial overgrowth by duodenal aspirate culture. Aliment Pharmacol Ther 2011; 33:1059–67.
11. Cangemi DJ, Lacy BE, Wise J. Diagnosing small intestinal bacterial overgrowth: A comparison of lactulose breath tests to small bowel sspirates. Dig Dis Sci 2021; 66: 2042–2050.
12. Lacy BE, Cangemi DJ, Wise JL, Crowell MD. Development and validation of a novel scoring system for bloating and distension: The Mayo Bloating Questionnaire. Neurogastroenterol Motil 2022;34: e14330.
13. Pasricha PJ, Grover M, Yates KP, et al. Functional dyspepsia and gastroparesis in tertiary care are interchangeable syndromes with common clinical and pathologic features. Gastroenterology. 2021; 160:2006–2017.
14. Cangemi DJ, Lacy BE. Gastroparesis and functional dyspepsia: different diseases or different ends of the spectrum? Curr Op in Gastroenterol 2020; 36:509–517.

15. Jones RM, Neish AS. Recognition of bacterial pathogens and mucosal immunity. Cell Microbiol. 2011; 13:670–676.
16. Lauritano EC, Gabrielli M, Scarpellini E, et al. Small intestinal bacterial overgrowth recurrence after antibiotic therapy. Am J Gastroenterol. 2008; 103:2031–2035
17. Agrawal A, Houghton LA, Lea R, et al. Bloating and distention in irritable bowel syndrome: the role of visceral sensation. Gastroenterology 2008; 134:1882–1889.
18. Coen SJ, Yaguez L, Aziz Q, et al. Negative mood affects brain processing of visceral sensation. Gastroenterology 2009; 137:253–261.

Figures

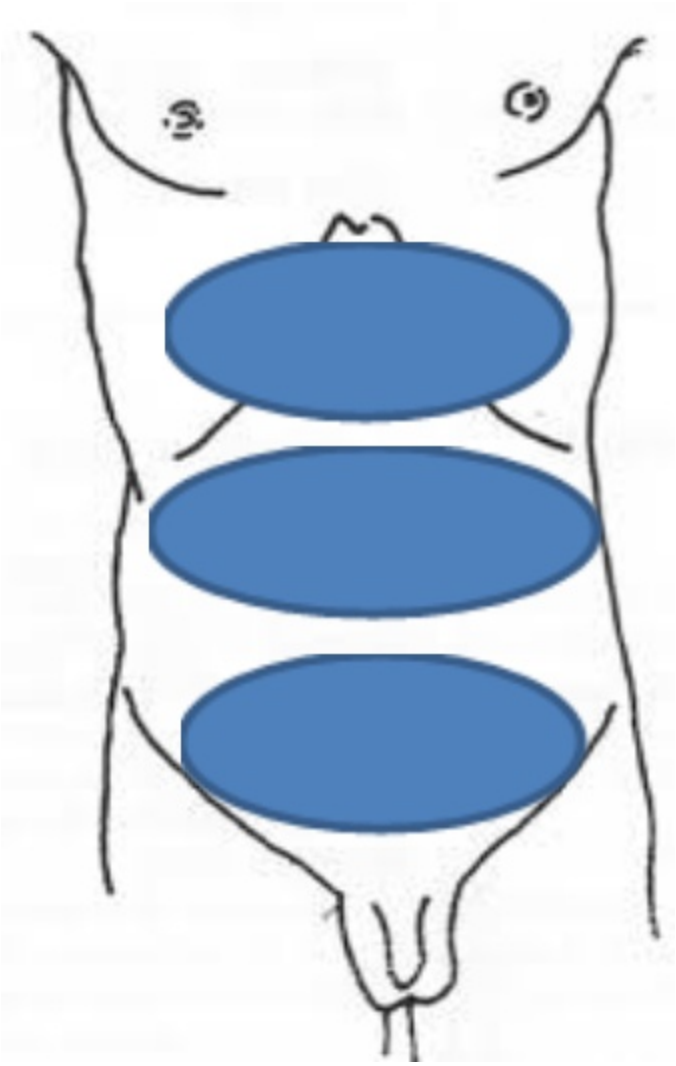

Figure 1

Abdominal pain locations of sampled patient population