International Journal of Gastroenterology
2025, Vol. 9, No. 1, pp. 32-36
https://doi.org/10.11648/j.ijg.20250901.15

Research Article

Frequency and Bacterial Profile of Small Intestinal Bacterial Overgrowth in Patients with IBS D and IBS M in an Academic Hospital

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Abstract

Background: Small intestinal bacterial overgrowth (SIBO) is a condition often associated with irritable bowel syndrome (IBS), particularly IBS-D (diarrhea-predominant) and IBS-M (mixed-type). The relationship between SIBO and IBS subtypes remains poorly understood, despite its potential impact on treatment and symptom management. *Methods*: This observational cross-sectional study was conducted at the Department of Gastroenterology, Dhaka Medical College Hospital, from September 2018 to August 2019. A total of 104 adult patients diagnosed with IBS based on Rome IV criteria were enrolled. Duodenal aspirates were collected during upper gastrointestinal endoscopy, and SIBO was diagnosed using quantitative aerobic culture on blood agar and MacConkey agar plates, with $\geq 10^5$ CFU/mL considered diagnostic. Demographic and clinical data were analyzed using SPSS software. *Results*: Of the 104 participants, 36.5% tested positive for SIBO. Among IBS-D patients, 53.3% were SIBO-positive, while only 13.7% of IBS-M patients showed positive results. The majority of isolates in the SIBO-positive group were Pseudomonas (78.9%), followed by E. coli (21.1%). A significant correlation was observed between SIBO and IBS-D, with higher colony counts in the SIBO-positive group. *Conclusion*: The study highlights a higher frequency of SIBO in IBS-D compared to IBS-M. Pseudomonas was the predominant bacterium isolated in patients with SIBO. These findings suggest the need for targeted management of SIBO in IBS-D patients.

Keywords

Small Intestinal Bacterial Overgrowth, IBS-D, IBS-M, Duodenal Aspirate, Pseudomonas, Microbiology

1. Introduction

Irritable bowel syndrome (IBS) is a functional gastrointestinal disorder characterized by recurrent abdominal pain or discomfort and alteration of bowel habits in the absence of structural abnormalities [1]. It is a common condition that occurs in a large proportion of the global population and has a marked impact on quality of life and healthcare utilization [2]. Based on stool pattern, IBS is classified into four subtypes: IBS with predominant diarrhea (IBS-D), IBS with predominant constipation (IBS-C), mixed-type IBS (IBS-M), and unclassified IBS (IBS-U), according to the Rome IV

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Received: 7 April 2025; **Accepted:** 18 April 2025; **Published:** 19 May 2025

criteria [3]. Among these, IBS-D and IBS-M are of particular interest since they have been associated with increased intestinal permeability and gut microbiota alterations, which may predispose patients to small intestinal bacterial overgrowth (SIBO) [4].

SIBO is an overgrowth of the number and/or type of bacteria in the small intestine, generally diagnosed when there are more than 10^5 colony-forming units per milliliter (CFU/ml) on duodenal aspirate cultures [5]. SIBO has been implicated in the pathophysiology of various gastrointestinal disorders, including IBS, and is thought to produce symptoms such as bloating, diarrhea, and pain in the abdomen [6]. Different investigations have reported heightened SIBO prevalence in IBS patients and, particularly, in IBS-D and IBS-M, suggesting an etiologic connection with microbial dysbiosis and symptoms [7]. However, SIBO's specific pathophysiologic role in varying IBS subtypes remains a target of research and controversy, due to the variability in detection methods and case series inclusion criteria [8].

The gold standard for the diagnosis of SIBO is small intestinal aspirates quantitative culture obtained by upper gastrointestinal endoscopy. Although more non-invasive breath tests using glucose or lactulose substrates are being used more and more to diagnose SIBO, these tests are restricted in specificity and sensitivity [9]. Culture allows direct counting and identification of bacteria so that a greater precision in the detection of SIBO and the offending bacterial species involved can be performed [10]. Characterization of the specific bacterial spectrum of SIBO and IBS patients may hold the key to pathophysiological mechanisms and tailoring specific therapeutic intervention, including antibiotic or microbiome-modulating interventions [11].

Considering growing awareness of the potential involvement of SIBO in IBS, data from the developing world, including Bangladesh, are still extremely sparse [12]. Given the regional differences in diet, antibiotic consumption, and medical care, local prevalence and microbiological patterns of SIBO in IBS patients should be determined by regional studies [13]. This study aimed to compare the rate of SIBO in IBS-D and IBS-M patients and investigate the spectrum of bacteria of duodenal aspirate cultures in an academic hospital. Through exploration of the microbial universe in IBS-related SIBO, the present study aimed to promote understanding of the disease and associated clinical significance toward ultimately guiding improved symptomatic patient management.

2. Methodology and Materials

This observational cross-sectional study was conducted at the Department of Gastroenterology, Dhaka Medical College Hospital, Dhaka, from September 2018 to August 2019, involving 104 adult patients diagnosed with irritable bowel syndrome (IBS) based on Rome IV criteria. Eligible participants included patients aged 18 years or older with IBS-D (diarrhea-predominant) or IBS-M (mixed-type) subtypes, while patients with IBS-C, organic gastrointestinal disorders, recent use of antibiotics, PPIs, probiotics, or motility-altering drugs within the last eight weeks, history of major abdominal surgery, or pregnancy were excluded. After obtaining informed consent, demographic and clinical data were collected using a structured questionnaire. Upper gastrointestinal endoscopy was performed under standard aseptic precautions, and 3-5 ml of duodenal aspirate was collected from the second part of the duodenum using a sterile catheter, which was immediately transported to the microbiology laboratory for culture and colony count analysis. Quantitative aerobic culture was performed using blood agar and MacConkey agar plates, incubated at 37°C for 24 to 48 hours, and the presence of $\geq 10^5$ colony-forming units per milliliter (CFU/ml) was considered diagnostic for small intestinal bacterial overgrowth (SIBO). Bacterial identification was performed using standard biochemical tests. All collected data, including demographic variables, IBS subtype, smoking status, and culture results, were recorded and analyzed using SPSS software (version 25), with categorical variables expressed as frequencies and percentages, while continuous variables were presented as mean ± standard deviation. Comparisons between SIBO and non-SIBO groups were made using chi-square tests for categorical variables and independent t-tests for continuous variables, with a p-value of less than 0.05 considered statistically significant.

3. Results

Table 1. *Demographic, Clinical and microbiological profile of study participants.*

Variables	IBS patients (n=104)
Age (Mean ± SD)	31.69± 10.01
Sex (Male)	78 (75%)
Occupation (service holder)	47 (45%)
Urban	61 (58.6%)
Nonsmoker	77 (74%)
IBS-D	60 (57%)
IBS-M	44 (42%)
Culture positivity	63 (60.6%)
SIBO	38 (36.5%)

This table presents the demographic, clinical, and microbiological characteristics of the study participants. Among the participants, 75% were male, 45% were service holders, and 58.6% resided in urban areas. A majority of the participants, 74%, were nonsmokers. Regarding the IBS subtypes,

57% had IBS-D while 42% had IBS-M. In terms of microbiological findings, 60.6% of the participants showed culture positivity, and 36.5% tested positive for SIBO.

Table 2. *Frequency of SIBO in Different Types of IBS (n=104).*

Types of IBS	No. of patients (104)	SIBO n (%)
IBS-D	60 (57.7%)	32 (53.3%)
IBS-M	44 (42.3%)	6 (13.7%)

Table 2 illustrates the distribution of small intestinal bacterial overgrowth (SIBO) among different IBS subtypes. Among the 60 patients with IBS-D (57.7%), 32 (53.3%) tested positive for SIBO. In contrast, among the 44 patients with IBS-M (42.3%), only 6 (13.7%) had SIBO. This indicates a higher prevalence of SIBO in IBS-D patients compared to IBS-M patients.

Table 3. *Distribution of colony count among participants (n=104).*

Colony count	No. of participants (n)
$<10^3$ CFU/ML	42 (40.4%)
10^3 - $<10^5$ CFU/ML	24 (23.1%)
$\geq 10^5$ CFU/ML	38 (36.5%)

Table 3 presents the distribution of bacterial colony counts among the study participants. A total of 42 participants (40.4%) had a colony count of $<10^3$ CFU/ml, while 24 participants (23.1%) had a colony count between 10^3 and $<10^5$ CFU/ml. Notably, 38 participants (36.5%) had a colony count of $\geq 10^5$ CFU/ml, meeting the diagnostic threshold for small intestinal bacterial overgrowth (SIBO).

Table 4. *Isolated bacteria on culture of duodenal aspirate among participants (n=104).*

Spectrum of bacteria isolated on culture	SIBO (n=38)	Non SIBO (n=66)
No growth	0 (0.0)	41 (62.1%)
Pseudomonas	30 (78.9%)	20 (30.3%)
E. Coli	8 (21.1%)	8 (12.1%)
Klebsiella	0 (0.0%)	1 (1.5%)
Citrobacter	0 (0.0%)	1 (1.5%)

Table 4 displays the distribution of bacterial isolates among SIBO and non-SIBO participants. In the non-SIBO group, 41 participants (62.1%) had no bacterial growth, whereas all 38 SIBO-positive participants (100%) had bacterial growth. Pseudomonas was the most frequently isolated bacteria, found in 78.9% of SIBO cases and 30.3% of non-SIBO cases. E. coli was present in 21.1% of SIBO cases and 12.1% of non-SIBO cases. Klebsiella and Citrobacter were only detected in the non-SIBO group, each in 1.5% of cases.

4. Discussion

Small intestinal bacterial overgrowth (SIBO) has been increasingly implicated in the pathophysiology of irritable bowel syndrome (IBS), particularly the diarrhea-predominant (IBS-D) and mixed-type (IBS-M) subtypes. In this study, the overall prevalence of SIBO among IBS patients was 36.5%, with a significantly higher frequency in IBS-D (53.3%) compared to IBS-M (13.7%). This aligns with findings from Ghoshal et al., who reported a higher prevalence of SIBO in IBS-D patients, suggesting a possible link between bacterial overgrowth and accelerated gut transit time [11]. Similarly, Pimentel et al. found that SIBO was present in nearly 78% of IBS patients diagnosed via glucose or lactulose breath tests, reinforcing the role of small intestinal dysbiosis in IBS pathogenesis [14].

Comparing previous studies, the SIBO prevalence in IBS patients varies widely depending on the diagnostic method used. Ford et al. conducted a meta-analysis and reported a pooled SIBO prevalence of 38%, which is comparable to our findings using culture-based methods [15]. However, Shah et al. found a significantly lower prevalence (20%) when using the glucose hydrogen breath test, which might underestimate SIBO due to the limited reach of glucose in the small intestine [16]. In contrast, Ghoshal et al. suggested that duodenal aspirate culture, as used in our study, remains the gold standard despite being more invasive [17].

The bacterial spectrum identified in our study also provides insight into the microbial shifts in SIBO-positive patients. Among those with SIBO, Pseudomonas species were the predominant isolates (78.9%), followed by E. coli (21.1%). This is consistent with the findings of Aktan et al., who reported an overgrowth of facultative anaerobes, including Pseudomonas and Enterobacteriaceae, in IBS patients with SIBO [18]. Ghoshal et al. also observed a predominance of Gram-negative bacilli in their culture-based studies, indicating a dysbiotic shift in the small intestine [17]. The lower prevalence of Klebsiella and Citrobacter in our study mirrors the results of Zhao et al., who found these organisms in only a small subset of SIBO cases [19].

Our study also highlights the correlation between colony count and SIBO diagnosis. A colony count of $\geq 10^5$ CFU/ml was found in 36.5% of patients, aligning with the diagnostic threshold recommended by Lin et al., who emphasized that

this cutoff differentiates pathological bacterial overgrowth from normal microbial colonization [20]. Furthermore, our finding that 23.1% of IBS patients had colony counts between 10^3 and $<10^5$ CFU/ml suggests the presence of a subclinical form of bacterial overgrowth, which has been previously debated in the literature. Shah et al. proposed that a lower threshold might be needed for IBS patients, as even moderate bacterial overgrowth could contribute to symptom generation [16].

The clinical implications of our findings are particularly relevant in light of therapeutic approaches. Studies by Pimentel et al. and Shah et al. demonstrated that antibiotic therapy targeting SIBO, such as rifaximin, significantly improves IBS symptoms, particularly in IBS-D patients [14, 16]. Given the high prevalence of Pseudomonas and E. coli in our cohort, antibiotic selection should consider coverage for these organisms. Additionally, Rana et al. emphasized the role of prokinetics in IBS patients with recurrent SIBO, suggesting that motility disturbances may predispose individuals to bacterial overgrowth [21].

The culture-based approach, while specific, may not detect anaerobic organisms, which are commonly implicated in SIBO. Ghoshal et al. suggested that breath testing, although less specific, may provide complementary diagnostic information [17].

5. Limitations of the Study

This study has some limitations, including its single-center design, which may limit the generalizability of findings. The culture-based method, while specific, may not detect anaerobic bacteria, potentially underestimating SIBO prevalence. Additionally, the cross-sectional nature of the study prevents assessment of causal relationships between SIBO and IBS symptoms.

6. Conclusion

In conclusion, our study confirms a significant association between SIBO and IBS, particularly in IBS-D patients. The predominance of Pseudomonas and E. coli suggests a dysbiotic shift that may contribute to symptom generation. These findings support the need for routine SIBO screening in IBS patients and highlight the potential role of targeted antibiotic therapy in managing symptoms. Further multicenter and longitudinal studies are warranted to validate these findings and explore effective treatment strategies for IBS-related SIBO.

Abbreviations

IBS	Irritable Bowel Syndrome
IBS-D	IBS with Predominant Diarrhea
SIBO	Small Intestinal Bacterial Overgrowth

Funding

No funding sources.

Conflicts of Interest

The authors declare no conflicts of interest.

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