

Exploring the Impact of Yoga Intervention on Psychological Symptoms in Irritable Bowel Syndrome Patients: A Randomized Controlled Study

Abstract

Background: Irritable bowel syndrome (IBS) is an extremely prevalent gastrointestinal disorder that has an unfavorable impact on the living standard and IBS-related multiple symptoms. 11%–15% of people worldwide are suffering from IBS. Secondary symptoms such as depression or anxiety are experienced by IBS patients. Yoga practices combined with traditional medical treatment can be a successful therapy for IBS. **Objectives:** The objective of this randomized control research was to observe the effectiveness of the yoga intervention as an add-on therapy in IBS patients with conventional treatment and its comparison with IBS with conventional treatment as a control. **Materials and Methods:** The suggested research is an open-blinded, prospective, randomly assigned, single-center, parallel-group, and end-point trial. Patients with IBS who satisfied the Rome IV criteria for diagnosis were recruited and randomly allocated into two groups: Intervention Group A (Yoga + conventional treatment) and Control Group B (Conventional treatment only). Group A ($n = 85$) received yoga intervention five times a week for 3 months, and Group B ($n = 80$) took their prescribed medication without yoga intervention. Psychological symptoms and IBS severity scores before and after yoga intervention were measured and compared with the control group with the help of validated questionnaires: Depression, Anxiety, and Stress Score (DASS-21) and IBS Severity Score, respectively. **Results:** The body weight and body mass index after 3 months of follow-up were significantly lowered ($P < 0.05$) in the yoga intervention group as compared to the control group. The overall severity of IBS after yoga interventions in Group A (259.2 ± 49.9 – 256.1 ± 48.6 , $P < 0.01$) was significantly reduced than the control group (270 ± 56.6 – 271.9 ± 54.8 , $P > 0.05$). Moreover, the psychological stress ($P < 0.05$) and anxiety ($P < 0.01$) scores were also significantly decreased after 3 months of follow-up in the yoga intervention group. The serum cortisol level was decreased in Group A. However, it could not reach a significant level. **Conclusion:** The current study indicates an affirmative result of yoga intervention along with conventional treatment for patients with IBS might be strongly advised.

Keywords: Anxiety, Depression, Anxiety, and Stress Score-21 scale, irritable bowel syndrome, serum cortisol, stress, yoga intervention

Introduction

Irritable bowel syndrome (IBS) is the most widespread functional gastrointestinal (GI) disorder that leads to patients experiencing abdominal pain or uneasiness related to changed bowel behavior for 3 months or longer, without the presence of any clear clinical reason.^[1,2]

IBS can be divided into three subtypes: diarrhea (IBS-D), constipation (IBS-C), and mixed-pattern stool of evacuation and constipation (IBS-M). Although the root cause or etiology of disease has not yet been discovered, many individuals suffer from an extensive range of secondary signs such as anxiety, depressive disorder, migraines, headaches, and persistent fatigue.^[3-5]

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: WKHLRPMedknow_reprints@wolterskluwer.com

IBS prevalence range varies between 9% and 23% of people across the globe.^[6] Furthermore, in the Indian scenario, its prevalence is 15%, with a greater frequency in female individuals.^[7,8]

Patients with IBS typically declare a healthy family background of the conditions, with rates ranging from 33% to 42%. Having a family background of stomach discomfort, bowel dysfunction, or inflammatory bowel disease increases the probability of developing IBS.^[9]

Due to varying symptoms and the absence of a reliable test, diagnosing IBS can be challenging. In order to make a diagnosis,

How to cite this article: Devi D, Bhattacharya S, Tiwari S, Tripathi A, Singh K, Rungta S. Exploring the impact of yoga intervention on psychological symptoms in irritable bowel syndrome patients: A randomized controlled study. *Int J Yoga* 2025;18:58-66.

Submitted: 13-Sep-2024

Revised: 09-Nov-2024

Accepted: 14-Nov-2024

Published: 22-Apr-2025

Diksha Devi,
Sandeep
Bhattacharya,
Sunita Tiwari¹,
Adarsh Tripathi²,
Kalpana Singh³,
Sumit Rungta⁴

Departments of Physiology,
²Psychiatry, ³Biochemistry
and ⁴Gastroenterology,
King George's Medical
University, ¹Department
of Physiology, Dr. Ram
Manohar Lohia Institute of
Medical Sciences, Lucknow,
Uttar Pradesh, India

Address for correspondence:
Dr. Sandeep Bhattacharya,
Department of Physiology, King
George's Medical University,
Lucknow, Uttar Pradesh, India.
E-mail: sandeep12101975@
gmail.com

Access this article online

Website: <https://journals.lww.com/IJOY>

DOI: 10.4103/ijoy.ijoy_200_24

Quick Response Code:



the Rome IV criteria, which were revised in 2016, emphasize symptoms such as pain or discomfort in the abdomen and changes in the frequency or appearance of stools that have persisted for at least three months. IBS is still difficult to diagnose because its symptoms overlap with those of other gastrointestinal illnesses, even with these criteria helping to standardize diagnosis.^[10,11]

IBS causes mental issues and changes in bowel habits by upsetting the balance between the gut–brain axis. It may follow an infection or health problems that may be affected by complicated lifestyle choices and long-term medical disorders.^[12,13] Psychological stressors such as anxiety and depression have the potential to impact intestinal health.^[14] The effects of stress (both mental and physical) raise the levels of the glucocorticoid stress hormone, known as cortisol. It is released in the blood when the hypothalamic–pituitary–adrenal (HPA) axis is stimulated. Therefore, it works as a stress reflex biomarker.^[13,15] Its peak is found in the early morning, while its lowest is at midnight.^[15]

A number of adverse effects, including headache, nausea, dry mouth, cramps, severe constipation, and blurred vision, occurred with the large number of pharmaceutical treatments that aim to give particular symptomatic alleviation. Approximately half of IBS patients frequently find complementary therapies without any adverse effects, such as yoga, probiotics, Chinese herbal therapy, and hypnotherapy.^[4,16,17]

In India, the majority of people are interested in performing or practicing yoga and meditation. Therefore, it would be easily convincing and feasible for IBS patients to treat the disease with yoga as an add-on therapy along with conventional treatment. Yoga is a long-time ancient practice and Eastern Indian custom that has been modified for use in alternative medicine, particularly in the prevention and treatment of medical illness. In traditional yoga, postures are performed, breathing is controlled, and meditation is practiced. Yoga is known to reduce oxidative stress in the body in addition to stabilizing the HPA axis. It is another form of mind–body alternative treatment therapy.^[1,18]

As envisioned by the WHO, yoga combines physical and mental discipline to support personal growth that leads to perfect health.^[19]

Previous studies suggested that yoga, particularly Hatha yoga, has been linked to improve psychological and physiological health in patients suffering from IBS, as well as bestow relief from GI symptoms, reduced perceived stress, and negative emotions.^[19,20] Various pieces of literature indicate that yoga by itself or in conjunction with traditional medical treatment may provide a long-term and effective treatment for IBS symptoms.^[3,21,22]

In the Indian scenario, there are three yoga intervention studies (Yoga vs. Conventional Treatment [2004], Yoga Therapy [2019], and Yoga and Naturopathy Treatment

[2024]) that have already explored the effects of yoga on IBS patients. However, these studies did not see the effect of yoga on psychological parameters, particularly Depression, Anxiety, and Stress Scale (DASS-21), and association with cortisol levels in IBS patients. Although in Western countries, research has been done that has explored the importance of yoga intervention on IBS signs and symptoms.

The aim of the current randomized study was to assess the effect of specific yoga intervention as an add-on therapy with conventional treatment patients with IBS. This study includes all the main components of yoga, body–breath–mind (postures, regulated breathing, and guided meditation) to be performed five times a week, supervised by a yoga trainer, and assesses the effect of yoga intervention on DASS-21 (Depression, Anxiety, and Stress Scale) and its association with cortisol level (a stress marker) in IBS patients.

Materials and Methods

Study design

The study enrolled 376 after being referred by a medical professional in the outpatient department (OPD) of the Gastroenterology Department, King George's Medical University, Lucknow, India. Overall, 214 patients were screened in this randomized controlled study. According to the inclusion and exclusion criteria, 165 recruited patients were randomly assigned into two groups: intervention group ($n = 85$) and control ($n = 80$) with the help of computer-generated random number table method. Eighty-two patients were excluded for not meeting the inclusion criteria; 53 patients declined to participate, and 27 were excluded because of other reasons. Following the assignment of patients to the groups, baseline parameters (e.g. sociodemographic, psychological, and serum cortisol) were evaluated before and upon completion of the 3-month follow-up.

After completing their yoga intervention on completion of a 3-month follow-up, 85 and 80 patients in the yoga intervention and control groups, respectively, based on the group they were assigned and finished the trial. The loss to follow-up was 25 in the yoga intervention group and 24 in the control group as shown in Figure 1.

The study was approved by the King George's Medical University's Ethics Committee (Approval No. 2580/PHY/22 dated June 23, 2022), and was carried out in accordance with the Helsinki Declaration. It is also registered on the Clinical Trial Registry of India (Registration No: CTRI/2023/05/053048) before the patient recruitment.

Patients

As per the inclusion criteria, patients aged 18–45 years were diagnosed according to Rome IV guidelines.^[23] Patients who did not engage in any yoga practices or any

other alternative medicine course related to their health at the time of study and who were not involved in any other ongoing research activities were also included. Those patients who had undergone any surgery (e.g. GI surgery) and had other medical or chronic illnesses, e. g., diabetes, arthritis, cardiovascular disease, respiratory disease, or chronic renal disease were excluded. Patients were excluded from the study for having a history of drug, alcohol, chemical abuse, or any physical or mental disability.

Randomization

All subjects, upon signing an informed consent form, were randomly assigned (using the computer-generated random number table method) into two groups: Intervention Group A (yoga + conventional treatment) and Control Group B (conventional treatment only). The yoga intervention group and control group were planned to differentiate between the effects of yoga with conventional treatment and only conventional treatments on IBS symptoms, respectively. Both groups were examined at baseline (0 months) and after 3 months of follow-up to determine the optimal period of yoga intervention for their well-being. Data collection was completed from August 2022 to March 2024.

Intervention

Control group

IBS patients continued their conventional treatment (medications) if any, under the guidance of their physician, and regularly monitored that they were not doing yoga by

themselves or from other sources. They went about their normal daily routine.

Yoga intervention group

IBS patients with yoga intervention (Group A) were introduced to a yoga intervention program that involved weekly, 1-h sessions for 3 months of yoga. The program, conducted by online classes, focused on relaxation exercises, asana, and pranayama [Table 1]. The sessions were designed to assist patients in connecting with their inner divinity, diminishing negativity, and encouraging consistent home yoga practices with an empty stomach. Initially, patients were informed about the asana, pranayama, and meditation, made comfortable, and given orientation for the initial 2–3 days. Yoga training was given for 1 h (6–7 a.m.) 5 days a week for 3 months virtually (via the Goggle Meet app) by a yoga teacher in an open place. The session began with some relaxing exercises to connect with the inner divine and let go of negativity and then practiced different types of meditative asana and pranayama, as shown in Table 1. After these practices, a guided meditation session for 10 min was conducted. Occasionally, the sessions lasted an extra 5–10 min as some new patients required more attention. Subjects will be advised to follow yoga practices at home regularly for 1 h at the morning or evening with an empty stomach.

A video script containing all yoga practices listed in the Table 1 was developed to keep standardization of training and minimizing variation during the training for

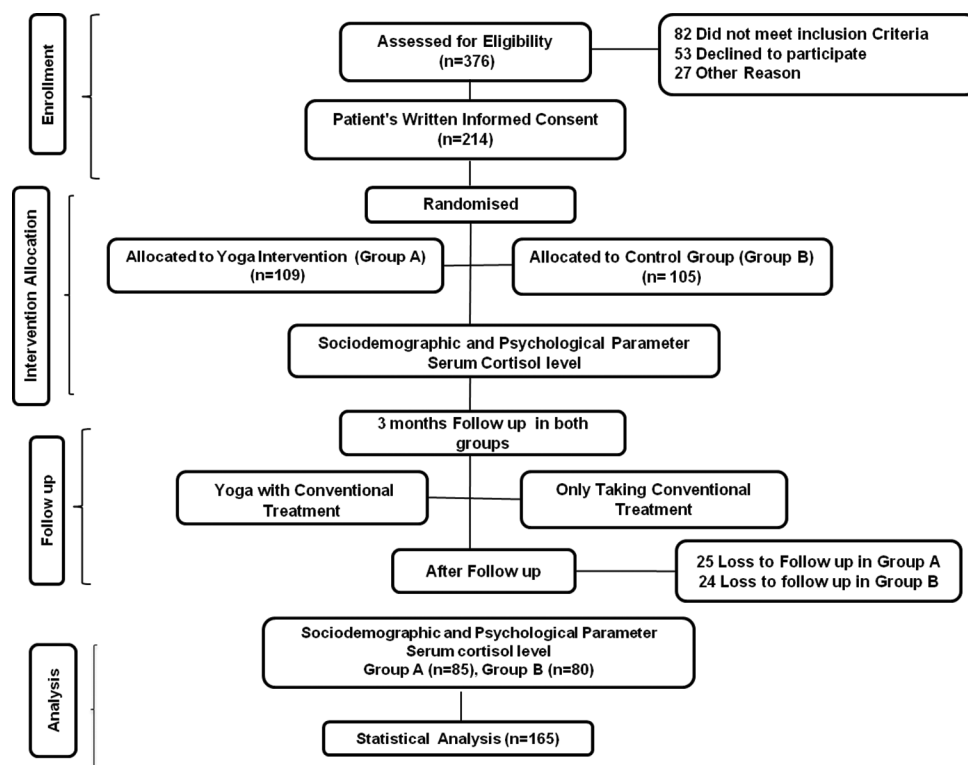


Figure 1: Diagram demonstrating the research protocol

patients in the study. They were monitored by phone calls to confirm their regular home practice during the study. This was to ensure that the module was followed exactly the same during home practices as they were doing physically in a live yoga session (online) for their all over well being [Table 2]. The conventional treatment (medication) will be continued for all the patients during the intervention period.

Statistical analysis

Data were presented as number (*n*), percentage (%), and mean \pm standard deviation. Groups were compared at their baseline and follow-up by appropriate statistical tests after a normality check. The normality of the data was examined through the Kolmogorov–Smirnov Normality test. For the parametric data, we compared within the group and between two groups by performing paired *t*-test and unpaired-test, respectively. While for the nonparametric data, we compared within the group and between two groups by performing the Wilcoxon signed ranked *t*-test and Mann–Whitney *U*-test, respectively. The *P* values were

considered significant at $P < 0.05$ and $P < 0.01$. Degree of freedom for the yoga intervention group and control group is 84 and 79, respectively. All the statistical investigation was conducted using MS Excel and GraphPad Prism 8.0.2 (GraphPad Software, LLC, California, United States).

Demographic characteristics

We measured demographic details of IBS patients, such as age, sex, weight, height, and body mass index (BMI). Prevalidated questionnaires (IBS severity score) and the DASS-21 scale were used to collect data.

Irritable bowel syndrome diagnosis tool

In accordance with the Rome IV criteria, an individual experiences recurrent stomach discomfort for a minimum of 1 day every week for 3 months, with symptoms onset 6 months earlier to identification. In addition, the patient must meet the following conditions in addition to reporting stomach pain: (1) Defecation (pain either getting better or getting worse). (2) Modification in the frequency of stools. (3) Modification in stool form (the visual appeal). The IBS patients were further divided into three groups: constipation-predominant IBS (IBS-C), diarrhea-predominant IBS (IBS-D), and mixed IBS (IBS-M).^[23]

Irritable bowel syndrome severity scoring scale

The self-identified indicator, IBS severity scoring scale (IBS-SSS), measures pain intensity, frequency, bowel habits, and daily living interference, with higher scores indicating more severe symptoms. There is a maximum allowable score of 500 on the IBS-SSS; higher scores correspond to more severe symptoms. Scores of 75–175, 175–300, and >300, respectively, indicate mild, moderate, and severe cases. A clinically relevant improvement is defined as a decline of 50 points or more.^[27]

Depression, Anxiety, and Stress Scale-21

There are 21 Likert-type items in all, each with four possible answers (0–3). The depression, anxiety, and stress domains are evaluated on each subscale. Each domain has a total that varies from 0 to 21, and the sum is multiplied by 2 to get the final score. Each subscale's final score indicates whether the item should be classified as normal, mild, moderate, severe, or extremely severe. The depression domain is represented by items 3, 5, 10, 13, 16, 17, and 21. Scores 0–9 represent no depression (normal), 10–13 mild depression, 14–20 moderate depression, 21–27 severe depression, and scores above 28 highly severe depression. Items 2, 4, 7, 9, 15, 19,

Table 1: Yoga Intervention

Type of Yoga Practices	Name of Yoga Practices	Duration (45 minutes)
Relaxing Exercise	Head Rotation	5
	Hand Rotation	
	Forward Bending	
	Backward Bending	
	Side Bending	
Standing Asana	Tadasana	5
	Trikonasana	
	Padhastana	
	Hastottanasana	
	Butterfly Pose	
Sitting Asana	Paschimotanasana	5
	Mandookasana	
	Shashankasana	
	Bhujangaasna	
	Dhanurasna	
Prone Asana	Naukasna	5
	Markatasana	
	Ardh Halasana	
Supine Pose	Savasana	5
	Anulom-Vilom Pranayama	
Pranayama	Bhramari Pranayama	10
Meditation	Guided Meditation	10

Table 2: Physiological and psychological benefit of asana, pranayama, and meditations on IBS patients

Practice	Physiological Benefits	Psychological Benefits	Reference
Asana	Stimulates digestion and boosts metabolism	Enhances focus, emotional stability, and self confidence	[24,25]
Pranayama	Balance nervous system and reduces blood pressure	Reducing anxiety and depression	[25,26]
Meditation	Lowers stress hormone levels, enhances immune response and promotes overall relaxation	Balance autonomic nervous system and increase sleep quality	[15,26]

and 20 are associated with anxiety. Scores 0–7 indicate no anxiety (normal), 8 and 9 indicate mild anxiety, 10–14 show moderate anxiety, 15–19 indicate severe anxiety, and scores above 20 indicate highly serious anxiety.

The stress score, lastly, is a response to items 1, 6, 8, 11, 12, 14, and 18. Scores ranging from 0 to 14 indicate a normal outcome (no stress), while scores from 15 to 18 indicate mild stress, 19–25 moderate stress, 26–33 extreme stress, and scores above 34 indicate extreme stress.^[28]

Biochemical investigation

Sample collection

2 ml blood samples were collected in the morning before breakfast (9–10 am), in a plain vacutainer vial under aseptic conditions in both groups (yoga intervention and control group). All samples were given to clot at room temperature for 1 h and centrifugation at 300 rpm. After centrifugation, serum was separated and stored at –80°C for cortisol test. Serum cortisol was tested by the chemiluminescent microparticle immunoassay (CMIA) method with the help of Cortisol kit (Alinity i Cortisol Reagent Kit). This assay is a delayed single-step immunoassay for the quantitative determination of cortisol in the human blood (serum). The measurement range of the used Alinity i Cortisol Reagent Kit was from 3.7 to 19.4 µg/dL for morning time.

Results

In this study, we have seen the effects of yoga as an additional therapy in IBS patients with conventional treatment. Yoga intervention (Group A) and control group (Group B) were compared to elucidate the effects of yoga on psychological

parameters such as DASS 21 (for anxiety and depression) and IBS severity symptoms. In addition, serum cortisol levels were also compared among both groups. A total of 165 IBS patients were included in the study. Out of the 165, 129 (78.18%) patients were male and 36 (21.82%) were female patients who participated in this study, as shown in Table 3.

IBS is categorized into three subtypes such as IBS-C predominant, IBS-D predominant, and IBS-M. In terms of IBS symptom subtypes, IBS-C (61.82%) was the most prominent and frequent symptom among IBS patients. For IBS-C, IBS-D, and mixed symptoms, there were 58.82% of patients who suffered from IBS-C, 20% suffered from IBS-D, and only 21.18% had mixed IBS in Group A. In Group B, there were 65% patients who suffered from IBS-C, 6.25% suffered from IBS-D, and 28.75% had mixed IBS. About 4.24% of IBS patients who were included in our study had a psychiatric problem in the past, while 7.87% had a family history of psychiatric disorder.

Baseline demographic characteristics of both groups (yoga intervention and control group)

Demographic characteristics (age, weight, height, BMI, age at onset of IBS symptoms, and total duration of IBS) between two groups (yoga intervention and control group) were statistically insignificant at baseline [Table 4]. The mean BMI in the yoga intervention group was 22 ± 3.2 kg/m², while in the control group, it was 21.8 ± 4.5 kg/m² at the beginning of the study.

Demographic characteristics (age, weight, height, BMI, age at onset of IBS symptoms, and total duration of IBS) between two groups (yoga intervention and control

Table 3: Sociodemographic baseline characteristics of both groups (Yoga intervention and control group)

Variables of study	Total patients (n=165), n (%)	Group A (n=85) n (%)	Group B (n=80), n (%)
Gender			
Male	129 (78.18)	73 (85.88)	56 (70)
Female	36 (21.82)	12 (14.12)	44 (30)
Domicile			
Urban	70 (42.42)	38 (44.71)	32 (40)
Semi-urban	31 (18.79)	15 (18.29)	16 (20)
Rural	64 (38.79)	32 (37.65)	32 (40)
Type of IBS			
Constipation predominant	102 (61.82)	50 (58.82)	52 (65)
Diarrhea predominant	22 (13.33)	17 (20)	5 (6.25)
Mixed	41 (24.85)	18 (21.18)	23 (28.75)
Socioeconomic status according to Prasad's socioeconomic classification ^[29]			
Upper class	106 (64.24)	55 (64.71)	51 (63.75)
Upper middle class	45 (27.27)	23 (27.05)	22 (27.5)
Middle class	7 (4.24)	3 (3.53)	4 (5)
Lower middle class	6 (3.64)	4 (4.71)	2 (2.5)
Lower class	1 (0.61)	0	1 (1.25)
Any history of psychiatric problem	7 (4.24)	5 (5.88)	2 (2.5)
Family history of psychiatric problem	13 (7.87)	5 (5.88)	6 (7.5)

Values are presented in (%) percentage and n (number of patients), IBS. IBS: Irritable bowel syndrome

group) were statistically insignificant at baseline [Table 4]. The mean BMI in the yoga intervention group was 22 ± 3.2 kg/m², while in the control group was 21.8 ± 4.5 kg/m² at the beginning of the study.

Changes from baseline to 3 months follow up in weight, body mass index and cortisol level of both groups (yoga intervention and control group)

Comparison within the yoga intervention group at baseline and follow-up showed a significant reduction in weight and

BMI ($P < 0.05$), whereas in the control group, it did not show a significant change (baseline to follow-up) in weight and BMI ($P > 0.05$). At the beginning of the intervention, the level of serum cortisol was found to be nonsignificant among the groups. In the yoga intervention group, there was a slight reduction in serum cortisol level from 9.7 ± 4.46 to 9.4 ± 4.47 after 3-month follow-up, but the change could not reach at significant level. Furthermore, in the control group, there was minor increase in serum cortisol level from 9.46 ± 3.86 to 9.52 ± 4.05 , but it was not considered statistically significant [Table 5].

Changes from baseline to follow-up in irritable bowel syndrome-severity score of both groups (yoga intervention and control group)

Overall IBS-severity score showed a significant improvement when compared within yoga intervention group at their baseline and follow-up ($P < 0.01$). At the start of the intervention, the overall IBS severity score and its five subscales were found to be non-significant between yoga intervention and control group. At the baseline, the mean value was 259.2 ± 49.9 and after follow-up, it was 254.4 ± 49.54 in the yoga intervention group, which was decreased. The baseline mean value was 270 ± 56.6 , and after follow-up, it was 271.9 ± 54.8 , which did not increased significantly ($P > 0.05$) in the control group.

The five subscales of IBS-SSS were accomplished in detail [Table 6]. Significant improvements were observed in three subscales: distension of abdominal ($P < 0.01$), bowel satisfaction ($P < 0.01$), and interference with life ($P < 0.05$) in the yoga intervention group, but the other two subscales, the pain severity and the duration of pain did not indicate any significant changes ($P > 0.05$).

Changes from baseline to follow-up in Depression, Anxiety and Stress scale (DASS-21) of both groups (yoga intervention and control group)

Significant drops in scores were observed in the DASS-21 subscales for stress, anxiety, and depression ($P < 0.01$) in

Parameter	Group	Baseline (mean±SD)	Statistics
Age (years)	Yoga intervention	30.28±7.73	$P=0.101^{ns}$
	Control	32.36±8.19	CI=0.000–5.000 ES=–0.2612
Weight (kg)	Yoga intervention	58.89±9.58	$P=0.099^{ns}$
	Control	56.23±8.97	CI=–5.000–0.000 ES=0.2866
Height (cm)	Yoga intervention	163.58±7.59	$P=0.266^{ns}$
	Control	162±15.68	CI=–5.000–1.000 ES=0.1283
BMI (kg/m ²)	Yoga intervention	22±3.2	$P=0.313^{ns}$
	Control	21.8±4.5	CI=–1.700–0.6000 ES=0.0512
Age at onset of IBS symptoms (months)	Yoga intervention	27.27±7.57	$P=0.071^{ns}$
	Control	29.28±7.5	CI=0.000–5.000 ES=–0.2668
Total duration of IBS (years)	Yoga intervention	3.08±3.67	$P=0.503^{ns}$
	Control	3.02±3.36	CI=–1.000–0.2500 ES=0.0171

^{ns} $P>0.05$. Values are presented in mean±SD, comparison between the groups at baselines via Mann–Whitney U -test. SD: Standard deviation, CI: Confidence Interval, $P=P$ value, ns =non significant ES: Effect size, IBS: Irritable bowel syndrome, BMI: Body mass index, NS: Nonsignificant

Parameter	Yoga intervention group	Mean±SD	Statistics	Control group	Mean±SD	Statistics
Weight (kg)	Baseline	58.89±9.58	$P=0.0203^*$	Baseline	56.23±8.97	$P=0.081^{ns}$
	Follow-up	58.48±8.84	CI=–0.7987–0.09604 ES=0.0445	Follow up	56.08±9.14	CI=–0.4331–0.1206 ES=0.0166
BMI (kg/m ²)	Baseline	22.01±3.21	$P=0.0288^*$	Baseline	21.8±4.5	$P=0.076^{ns}$
	Follow-up	21.9±3.0	CI=–0.2763–0.01546 ES=0.0354	Follow up	21.8±4.5	CI=–0.06953–0.00047 ES=0
Serum cortisol (µg/dL)	Baseline	9.7±4.46	$P=0.157^{ns}$	Baseline	9.46±3.86	$P=0.895^{ns}$
	Follow-up	9.4±4.47	CI=–0.6577–0.04806 ES=0.0672	Follow up	9.52±4.05	CI=–0.3841–0.5168 ES=–0.0152

* $P<0.05$, ^{ns} $P>0.05$. Values are presented in mean±SD, Comparison within the group through Wilcoxon-matched pair test and paired t -test. CI: Confidence interval, ES: Effect size, BMI: Body mass index, SD: Standard deviation, NS: Nonsignificant

Table 6: Changes from baseline to follow-up in irritable bowel syndrome severity score of both groups (Yoga intervention and control group)

Serial number	Parameter	Yoga intervention group	Mean±SD	Statistics	Control group	Mean±SD	Statistics
1.	Total IBS severity	Baseline	259.2±49.9	$P=0.003^{**}$	Baseline	270±56.6	$P=0.355^{ns}$
		Follow-up	254.4±49.54	CI=-6.245-1.35	Follow up	271.9±54.8	CI=-2.147-5.922
				ES=0.0965			ES=-0.0341
1.1	Pain severity	Baseline	46.77±13.97	$P=0.202^{ns}$	Baseline	51.63±16.70	$P=0.807^{ns}$
		Follow-up	45.14±13.52	CI=-3.1-0.7055	Follow up	51.17±15.19	CI=-2.463-2.592
				ES=0.1186			ES=0.0288
1.2	Duration of pain	Baseline	49.35±21.46	$P=0.585^{ns}$	Baseline	50±19.49	$P=0.305^{ns}$
		Follow-up	47.67±15.46	CI=-5.35-2.199	Follow up	51.75±18.37	CI=-1.312-4.812
				ES=0.0898			ES=-0.0924
1.3	Abdominal distension	Baseline	53±14.76	$P=0.003^{**}$	Baseline	54.8±14.09	$P=0.950^{ns}$
		Follow-up	50.35±12.93	CI=-4.743-0.5514	Follow up	54.2±13.32	CI=-3.632-2.407
				ES=0.191			ES=0.0438
1.4	Bowel satisfaction	Baseline	54±13.18	$P=0.004^{**}$	Baseline	56.56±14.36	$P=0.816^{ns}$
		Follow-up	50.59±10.53	CI=-5.67-1.153	Follow up	56.34±12.83	CI=-2.798-2.423
				ES=0.2859			ES=0.0162
1.5	Interference with life	Baseline	57.29±12.71	$P=0.021^{*}$	Baseline	59.63±14.84	$P=0.893^{ns}$
		Follow-up	53.71±11.18	CI=-6.361-0.8155	Follow up	59.44±14.89	CI=-3.317-2.942
				ES=0.2991			ES=0.0128

* $P<0.05$, ** $P<0.01$, ^{ns}Nonsignificant. Values are presented in mean±SD, Comparison within the group through Paired *t*-test and Wilcoxon-matched pair test. CI: Confidence interval, ES: Effect size, IBS: Irritable bowel syndrome, SD: Standard deviation

Table 7: Changes from baseline to follow-up in Depression, Anxiety, and Stress Score-21 of both groups (Yoga intervention and control group)

Serial number	Parameter	Yoga intervention group	Mean±SD	Statistics	Control group	Mean±SD	Statistics
1.1	Depression	Baseline	18.2±6.9	$P=0.01^{**}$	Baseline	19.1±7.7	$P=0.1963^{ns}$
		Follow-up	17.4±6.8	CI=-1.357-0.1958	Follow up	19.4±7.2	CI=-0.221-0.871
				ES=0.1168			ES=-0.0402
1.2	Anxiety	Baseline	19.8±6.9	$P=0.001^{**}$	Baseline	21.5±7.4	$P=0.199^{ns}$
		Follow-up	18.8±6.62	CI=-1.378-0.3145	Follow up	21.9±6.7	CI=-0.1458-0.8958
				ES=0.1479			ES=-0.0567
1.3	Stress	Baseline	21.6±6.8	$P=0.01^{**}$	Baseline	23.3±6.8	$P=0.8973^{ns}$
		Follow-up	20.9±6.6	CI=-1.236-0.2231	Follow up	23.4±6.5	CI=-0.8094-1.009
				ES=0.1045			ES=-0.015

** $P<0.01$, ^{ns}Nonsignificant. Values are presented in mean±SD, comparison within the group through Wilcoxon-matched pair test. CI: Confidence interval, ES: Effect size, SD: Standard deviation

the yoga intervention group. A minor rise in the DASS-21 subscale scores was observed in the control group; however, it did not reach a significant level as mentioned in Table 7.

Discussion

Yoga is practiced by about 30 million people daily and is presently recognized in 193 countries across the globe.^[22] According to multiple yoga interventions, practicing yoga considerably reduced the intensity of IBS symptoms, psychological distress, fatigue, and poor sleep quality in patients with IBS in comparison to controls.^[8,26]

In this randomized control study, we observed a significant drop in weight ($P < 0.05$) and BMI ($P < 0.05$) in Group A (yoga intervention) after the 3-month follow-up. Consistently, the other study done on obese patients also resulted in people who practiced yoga reporting a significant decrease in their weight and BMI as compared to before they started the yoga care.^[30] This study also unveiled that controlling weight and BMI is required because both lowering psychological stress and increasing physical activity.^[30]

A before and after the study was done with medical students ($n = 30$) observed serum cortisol levels being significantly higher after the 4 consecutive days of mindfulness

meditation practice.^[31] Another yoga intervention study also indicates that in patients with depression who received yoga with or without medications ($n = 38$) for 3 months, the changes in serum cortisol levels were significant in the yoga intervention group ($P = 0.006$).^[15] In the present study, stress hormone serum cortisol level was not found statistically significant after 3 months of yoga intervention. Similar to these findings, a current study completed with healthcare workers did not show any significant change in the level of serum cortisol after 12 weeks of yoga intervention.^[18] The mechanism behind this is that the participant's mean cortisol level fell within the physiological range or the nonspecific range of the indicators. Yoga practices influence the HPA axis' stabilization, which normalizes serum cortisol to its physiological limit as opposed to simply reducing it. As an outcome, it was observed that the blood cortisol level was kept within typical physiological limits.^[18]

Recent studies reported a significant reduction in the severity and symptoms of IBS after the yoga practice (Ashtanga Yoga and Meditation) in IBS patients.^[8,32] Our study also showed similar findings and further confirmed that the severity of IBS reduced upon yoga intervention ($P < 0.01$). In addition, IBS symptoms such as abdominal distension, bowel satisfaction, and interference with life were significantly reduced, but two other symptoms, such as pain severity and duration, could not decrease up to a significant level. The possible reason for this might be because the primary symptom of IBS is pain, and a 3-month yoga intervention may not be adequate to significantly alleviate pain.

A significant affirmative effect of the 2-month Hatha yoga intervention (virtual practice) on stress, anxiety, and depression in research done with older adults.^[33] Similar to this finding, our study also reported a significant reduction in the DASS-21 score of depression, stress, and anxiety score in the yoga intervention group ($P < 0.01$), whereas the control group patients did not show any substantial change in these subscales after the 3-month follow-up. The findings of our study are in accordance with previous research suggesting that the regular practice of yoga practice can bring psychological advantages to IBS people.^[17,31]

Nonetheless, our research concentrated on maintaining a routine of yoga (asana, pranayama, and guided meditation) that would be potentially effective with using the least amount of conventional treatment. The results demonstrated a significant difference in the score of stress, anxiety, and IBS symptoms after 3 months of yoga intervention.

Some of the study's limitations are that the design of the intervention made it impossible to blind the patients. Moreover, there were 3-month duration of intervention, a small sample size, and a lack of interaction due to the online yoga session.

Conclusion

The beneficial effects of yoga intervention are stress reduction, improved sleep quality, increased physical

flexibility, greater emotional regulation, and an overall sense of well-being. It would be helpful for people, especially those who are struggling with GI/IBS symptoms as well as sleep deprivation and other stress-related problems. According to the study's findings, virtual yoga practice on a regular basis for at least 3 months can be a beneficial and more convenient way to alleviate psychological problems associated with IBS.

Acknowledgment

All the authors would like to express their gratitude to all the patients for their participation in this study.

Financial support and sponsorship

This study is supported by the National Testing Agency-University Grants Commission (ugc@nic.in).

Conflicts of interest

There are no conflicts of interest.

References

- Schumann D, Langhorst J, Dobos G, Cramer H. Randomised clinical trial: Yoga versus a low-FODMAP diet in patients with irritable bowel syndrome. *Aliment Pharmacol Ther* 2018;47:203-11.
- Quigley EM, Fried M, Gwee KA, Khalif I, Hungin AP, Lindberg G, *et al.* World Gastroenterology Organisation global guidelines irritable bowel syndrome: A global perspective update September 2015. *J Clin Gastroenterol* 2016;50:704-13.
- Kavuri V, Selvan P, Tabesh A, Raghuram N, Selvan SR. Remedial Yoga module improves symptoms of irritable bowel syndrome: Replication in the Wait-list group and sustained improvements at 6 months. *Eur J Integr Med* 2015;7:609-16.
- Quigley EM, Abdel-Hamid H, Barbara G, Bhatia SJ, Boeckxstaens G, De Giorgio R, *et al.* A global perspective on irritable bowel syndrome: A consensus statement of the World Gastroenterology Organisation summit task force on irritable bowel syndrome. *J Clin Gastroenterol* 2012;46:356-66.
- Cole JA, Rothman KJ, Cabral HJ, Zhang Y, Farraye FA. Migraine, fibromyalgia, and depression among people with IBS: A prevalence study. *BMC Gastroenterol* 2006;6:26.
- Alkalash SH, Almagadi RA, Alamri SM, Al-amri LA, Al-amri MA, Al-amri JM, *et al.* Prevalence and Risk Factors of Irritable Bowel Syndrome Among Adults in Al-Qunfudah Governorate, Saudi Arabia. *Cureus*; 2023. Available from: <https://www.cureus.com/articles/198283-prevalence-and-risk-factors-of-irritable-bowel-syndrome-among-adults-in-al-qunfudah-governorate-saudi-arabia>. [Last accessed on 2024 Jun 11].
- Saluja RK. Successful Yoga Prana Vidya (YPV) healing treatment of Irritable bowel syndrome (IBS): A case report. *IJMCRS* 2022;2. Available from: <https://ijmcrs.org/index.php/ijmcrs/article/view/184>. [Last accessed on 2024 Jun 10].
- Palanimurugan P, Arumugam V, Balakrishnan A, Annamalai G, Kuppusamy M, Venkateswaran ST, *et al.* Yoga and naturopathy intervention on psychological comorbidities and autonomic function for irritable bowel syndrome patient: A case study. *Brain Behav Immun Integr* 2024;5:100042.
- Surdea-Bлага T, Băban A, Dumitrascu DL. Psychosocial determinants of Irritable bowel syndrome. *World J Gastroenterol* 2012;18:616.

10. Arnaout AY, Nerabani Y, Douba Z, Kassem LH, Arnaout K, Shabouk MB, *et al.* The prevalence and risk factors of irritable bowel syndrome (PRIBS study) among adults in low- and middle-income countries: A multicenter cross-sectional study. *Health Sci Rep* 2023;6:e1592.
11. Zeeshan MH, Vakkalagadda NP, Sree GS, Anne KK, Devi S, Parkash O, *et al.* Irritable bowel syndrome in adults: Prevalence and risk factors. *Ann Med Surg* 2022;81:104408. Available from: <https://journals.lww.com/10.1016/j.amsu.2022.104408>. [Last accessed on 2024 Jul 05].
12. Banerjee A, Sarkhel S, Dhali GK, Paul I, Das A. A follow-up study of anxiety and depressive symptoms in Irritable bowel syndrome. *Indian J Psychiatry* 2024;66:142-7.
13. Lee DY, Kim E, Choi MH. Technical and clinical aspects of cortisol as a biochemical marker of chronic stress. *BMB Rep* 2015;48:209-16.
14. D'Silva A, Marshall DA, Vallance J, Nasser Y, Rajagopalan V, MacKean G, *et al.* Meditation and yoga for irritable bowel syndrome: Study protocol for a randomised clinical trial (MY-IBS study). *BMJ Open* 2022;12:e059604.
15. Thirthalli J, Naveen G, Rao M, Varambally S, Christopher R, Gangadhar B. Cortisol and antidepressant effects of yoga. *Indian J Psychiatry* 2013;55:405.
16. Shen YH, Nahas R. Complementary and alternative medicine for treatment of irritable bowel syndrome. *Can Fam Physician* 2009;55:143-8.
17. Lalit M, Nimisha NI, Jain K. Comparative effect of Yogasana and pranayama on depression, anxiety and stress levels in adults practitioners. *Int J Indian Psychol* 2020;8:961-6.
18. Misra P, Mandal S, Sharma G, Kant S, Rai S, Yadav K, *et al.* Effect of Structured Yoga Program on Stress and Well-being Among Frontline Healthcare Workers During COVID-19 Pandemic. *Cureus* [Internet] 2023. Available from: <https://www.cureus.com/articles/175587-effect-of-structured-yoga-program-on-stress-and-well-being-among-frontline-healthcare-workers-during-covid-19-pandemic>. [Last accessed on 2024 Jun 11].
19. Kavuri V, Raghuram N, Malamud A, Selvan SR. Irritable bowel syndrome: Yoga as remedial therapy. *Evid Based Complement Alternat Med* 2015;2015:1-10.
20. Yoshihara K, Hiramoto T, Oka T, Kubo C, Sudo N. Effect of 12 weeks of yoga training on the somatization, psychological symptoms, and stress-related biomarkers of healthy women. *Biopsychosoc Med* 2014;8:1.
21. Wang F, Szabo A. Effects of Yoga on stress among healthy adults: A systematic review. *Altern Ther Health Med* 2020;26:AT6214.
22. Biswajit Bhunia. Yoga to Manage Stress and Sports Performance. *Inter J Appl Soc Sci* 2020;7:601-4.
23. Palsson OS, Whitehead WE, Van Tilburg MA, Chang L, Chey W, Crowell MD, *et al.* Development and validation of the Rome IV diagnostic questionnaire for adults. *Gastroenterology* 2016;150:1481-91.
24. Setia G, Ramanathan M, Bhavanani AB, Prabu BS, Vinoth B, Ananthkrishnan N. Adjuvant yoga therapy for symptom management of functional dyspepsia: A case series. *J Ayurveda Integr Med* 2023;14:100715.
25. Devi D, Bhattacharya S. Role of Asana, Pranayama, and meditation as an add-on therapy in regulation of hypertension. *HTNJ* 2024;9:139-43.
26. Sengupta P. Health impacts of yoga and pranayama: A state-of-the-art review. *Int J Prev Med* 2012;3:444-58.
27. Francis CY, Morris J, Whorwell PJ. The irritable bowel severity scoring system: A simple method of monitoring irritable bowel syndrome and its progress. *Aliment Pharmacol Ther* 1997;11:395-402.
28. Henry JD, Crawford JR. The short-form version of the Depression anxiety stress scales (DASS-21): Construct validity and normative data in a large non-clinical sample. *Br J Clin Psychol* 2005;44:227-39.
29. Akram Z, Khairnar MR, Kusumakar A, Kumar JS, Sabharwal H, Priyadarsini SS, *et al.* Updated B. G. Prasad socioeconomic status classification for the year 2023. *J Indian Assoc Public Health Dent* 2023;21:204-5.
30. Kumari S, Damodara Gowda KM, Sukesh N, Madhu LN, Kathyayini. Effect of yoga therapy on body mass index and oxidative status. *J Health Allied Scie NU* 2011;01:10-4.
31. Turakitwanakan W, Mekseepralard C, Busarakumtragul P. Effects of mindfulness meditation on serum cortisol of medical students. *J Med Assoc Thai* 2013;96 Suppl 1:S90-5.
32. Kern D, Lindfors E, Lalér L, Lindfors A, Ljótsson B, Lindfors P. Ashtangayoga for irritable bowel syndrome in a primary care setting: A feasibility study. *Neurogastroenterol Motil* 2024;36:e14744.
33. Baklouti S, Fekih-Romdhane F, Guelmami N, Bonsaksen T, Baklouti H, Aloui A, *et al.* The effect of web-based Hatha yoga on psychological distress and sleep quality in older adults: A randomized controlled trial. *Complementary Therapies in Clinical Practice* 2023;50:101715.