

The Effectiveness of Mindfulness-Based Stress Reduction (MBSR) on Psychological Resilience and Somatic Symptoms (Somatization) in Adolescents with Irritable Bowel Syndrome (IBS)

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ABSTRACT

Objective: This study aimed to determine the effectiveness of Mindfulness-Based Stress Reduction (MBSR) in improving psychological resilience and reducing somatic symptoms among adolescents with irritable bowel syndrome (IBS).

Methods and Materials: This randomized controlled study employed a pretest–posttest design with a control group and a three-month follow-up. The statistical population consisted of adolescents aged 13–18 years with a confirmed diagnosis of IBS who attended pediatric gastroenterology clinics and specialized medical centers in Tehran, Iran, during 2026. A total of 40 eligible adolescents were selected and randomly assigned to an MBSR group ($n = 20$) and a control group ($n = 20$). The intervention group participated in eight weekly 90-minute MBSR sessions, while the control group received routine medical care without a structured psychological intervention. Data were collected using the Connor–Davidson Resilience Scale and the Children's Somatization Inventory-24 at pretest, posttest, and three-month follow-up. Data were analyzed using repeated-measures analysis of variance and Bonferroni-adjusted pairwise comparisons at a significance level of .05.

Findings: Repeated-measures analysis showed a significant time $\times$ group interaction for psychological resilience, $F(2, 76) = 38.57$, $p < .001$, partial $\eta^2 = .504$, and for somatization, $F(1.74, 66.12) = 43.21$, $p < .001$, partial $\eta^2 = .532$. Bonferroni comparisons indicated that psychological resilience increased significantly from pretest to posttest (mean difference = 16.25, $p < .001$) and remained significantly higher at follow-up (mean difference = 14.70, $p < .001$). Somatization significantly decreased from pretest to posttest (mean difference = 15.15, $p < .001$) and remained significantly lower at follow-up (mean difference = 13.70, $p < .001$). No significant differences were observed between posttest and follow-up for either outcome, indicating maintenance of treatment effects.

Conclusion: MBSR was effective in enhancing psychological resilience and reducing somatic symptoms in adolescents with IBS, and these improvements were maintained over a three-month follow-up period. The findings support the use of developmentally adapted MBSR as a complementary psychological intervention in multidisciplinary care for adolescents with IBS.

Keywords: *Mindfulness-Based Stress Reduction; Psychological Resilience; Somatization; Irritable Bowel Syndrome; Adolescents*

1. Introduction

Irritable bowel syndrome (IBS) is a chronic disorder of gut–brain interaction characterized by recurrent abdominal pain accompanied by alterations in bowel habits, including constipation, diarrhea, or a combination of both, in the absence of an identifiable structural or biochemical cause that adequately explains the symptoms. Although IBS has traditionally been studied predominantly in adults, increasing attention has been directed toward its occurrence during adolescence because this developmental period is accompanied by substantial biological, psychological, social, and educational changes that may interact with gastrointestinal functioning. Adolescents with IBS may experience recurrent abdominal discomfort, bloating, altered bowel movements, fatigue, sleep disturbance, and other somatic complaints that interfere with school attendance, interpersonal relationships, recreational activities, and overall quality of life. Evidence from adolescent populations suggests that IBS is not uncommon and can constitute a meaningful health problem during this age period. For example, research among Indonesian adolescents has documented the occurrence of IBS and highlighted its relevance as a pediatric and adolescent gastrointestinal condition requiring greater clinical attention (Kesuma et al., 2021). Similarly, investigations among adolescents have shown that IBS may be associated with difficulties extending beyond gastrointestinal symptoms, including reduced quality of school life and other health-related problems (Cho et al., 2018). These findings indicate that IBS in adolescence should not be conceptualized solely as a localized gastrointestinal disorder, but rather as a multidimensional condition in which physiological symptoms interact with emotional, cognitive, and behavioral processes.

The clinical significance of IBS in adolescence is amplified by the close relationship between gastrointestinal functioning and psychological processes. Contemporary conceptualizations of disorders of gut–brain interaction emphasize bidirectional communication among the central nervous system, autonomic nervous system, endocrine responses, immune mechanisms, and the gastrointestinal tract. Stress and negative emotional states can therefore influence gastrointestinal motility, visceral sensitivity, and perceptions of abdominal symptoms, while persistent or unpredictable gastrointestinal symptoms may themselves increase anxiety, worry, vigilance, and emotional distress.

Adolescents may be especially susceptible to this reciprocal process because they are simultaneously developing emotion-regulation capacities, autonomy, identity, peer relationships, and academic competence. Persistent gastrointestinal symptoms during this period can create uncertainty and heightened monitoring of bodily sensations, which may increase perceived symptom severity and functional impairment. Research has also identified significant associations between IBS and sleep-related difficulties in adolescents, indicating that the condition may be embedded within a broader pattern of psychological and behavioral dysregulation (Yang, 2021). Accordingly, interventions for adolescent IBS may benefit from targeting not only gastrointestinal complaints themselves but also the psychological mechanisms that determine how individuals perceive, interpret, and respond to physical discomfort.

One important psychological variable in this context is somatization. Somatization refers to the experience, amplification, and reporting of physical symptoms that are closely intertwined with psychological distress and that may not be fully explained by identifiable organic pathology. Somatic symptoms can involve multiple bodily systems and may include headaches, muscular pain, fatigue, dizziness, palpitations, gastrointestinal discomfort, and generalized bodily distress. In individuals with IBS, somatization is particularly relevant because attentional focus on bodily sensations, catastrophic interpretations of physical changes, stress-related physiological activation, and emotional distress may intensify awareness of gastrointestinal and non-gastrointestinal symptoms. Somatization can consequently contribute to greater perceived illness burden, increased healthcare utilization, functional disability, and poorer psychological adjustment. Previous research in patients with IBS has shown that mindfulness-oriented psychological interventions may reduce somatic symptoms alongside anxiety and depressive manifestations (Asadollahi, 2013). More recent investigations have similarly demonstrated that psychological interventions targeting mindfulness and cognitive-emotional processes can influence symptom severity among people with IBS (Nouri et al., 2023). These findings support the relevance of somatization as a clinically meaningful therapeutic outcome and suggest that psychological treatment may help modify the perceptual and emotional processes through which physical symptoms become distressing and disruptive.

In addition to reducing maladaptive symptom responses, effective psychological interventions for adolescents with IBS should ideally strengthen protective psychological resources. Psychological resilience is one such resource and broadly refers to the capacity to maintain or regain adaptive functioning when confronted with adversity, chronic stress, illness, or significant life challenges. Resilience does not imply the absence of distress; rather, it reflects flexible adaptation, perceived competence, effective emotion regulation, persistence, and the ability to recover from stressful experiences. During adolescence, resilience is particularly important because developmental demands occur alongside heightened sensitivity to peer evaluation, school pressures, family changes, identity-related concerns, and increasing expectations for autonomous coping. Adolescents living with a chronic or recurrent medical condition such as IBS may face additional burdens resulting from unpredictability of symptoms, embarrassment, restrictions in social participation, concern about symptom occurrence in school settings, and fear of losing control over bodily functioning. Consequently, insufficient resilience may contribute to more pronounced psychological distress and difficulty coping with IBS, whereas stronger resilience may facilitate more adaptive appraisal and management of symptoms.

Resilience is increasingly regarded as a modifiable capacity rather than a fixed personality attribute. Preventive and therapeutic programs aimed at adolescents have therefore sought to enhance resilience by developing emotional awareness, adaptive coping, stress-management skills, social support, and cognitive flexibility. School-based resilience programs have been designed specifically to strengthen adaptive resources among adolescents at psychological or social risk, reflecting growing recognition of resilience as a viable intervention target (Llistosella et al., 2023). Research focusing more directly on mindfulness has also suggested that resilience and mindful awareness are meaningfully connected during adolescence. Lower mindfulness has been associated with poorer psychological functioning through processes involving reduced resilience and greater emotional dysfunction, suggesting that resilience may represent one mechanism through which mindful awareness contributes to adaptive functioning (Zhou et al., 2023). Moreover, resilience has been examined alongside behavioral characteristics as an important correlate of mindfulness among adolescents, reinforcing the conceptual link between present-moment awareness and the capacity to

adapt effectively to stressful circumstances (Kapoor et al., 2024).

Mindfulness refers to purposeful and nonjudgmental attention to present-moment experiences, including thoughts, emotions, bodily sensations, and environmental events. Rather than automatically reacting to uncomfortable experiences, mindfulness encourages individuals to observe them with openness, curiosity, and reduced judgment. These skills may be particularly relevant for adolescents with IBS because symptoms can trigger cycles of anticipatory anxiety, hypervigilance, catastrophic interpretation, and behavioral avoidance. When an adolescent becomes highly focused on whether abdominal pain, urgency, or other symptoms will occur, heightened emotional and physiological arousal may further intensify gastrointestinal sensations. Mindfulness may interrupt this process by teaching adolescents to observe internal experiences without immediately evaluating them as threatening or intolerable. This change in attentional and emotional stance may promote greater acceptance of transient bodily sensations, reduce automatic stress responses, improve emotion regulation, and support more adaptive coping with recurrent symptoms.

The potential benefits of mindfulness during adolescence have been demonstrated in several recent studies. A mindfulness-based intervention developed for heterogeneous adolescent clinical populations was associated with improvements in mindful awareness and resilience-related skills, illustrating the feasibility of mindfulness-oriented approaches in youth receiving clinical services (Vo et al., 2024). Mindfulness training has likewise been found to positively affect resilience and emotional regulation among adolescents, indicating that mindfulness practice may strengthen the ability to manage emotional pressure and recover from stressful events (Navidi Moghadam, 2025). Furthermore, mindfulness-based cognitive therapy has demonstrated beneficial effects on resilience among adolescents, together with improvements in psychological processes such as rumination and sleep quality (Mohammadpanah Ardakan et al., 2024). Evidence from adolescent girls with chronic cardiac disease also suggests that mindfulness-based cognitive therapy can increase quality of life and resilience, supporting the applicability of mindfulness interventions to adolescents coping with persistent physical health problems (Akbarinejad & Naqizadeh Alamdari, 2023). Collectively, these findings provide a compelling basis for examining mindfulness as an approach to strengthening psychological

resilience among adolescents facing the recurrent stress associated with IBS.

Among established mindfulness interventions, Mindfulness-Based Stress Reduction (MBSR) is one of the most widely recognized structured programs. Originally developed to help individuals cope more effectively with chronic pain and stress-related health difficulties, MBSR typically integrates mindfulness meditation, body-scan practice, mindful movement, awareness of breathing, and the intentional application of mindfulness to everyday stressful experiences. The approach does not primarily seek to eliminate unpleasant sensations or thoughts. Instead, it teaches participants to modify their relationship with such experiences by reducing automatic reactivity and increasing awareness, acceptance, and self-regulation. This orientation may be especially appropriate for IBS, in which efforts to control or avoid gastrointestinal sensations can sometimes intensify vigilance and distress. By repeatedly observing bodily sensations without immediate judgment or avoidance, individuals may develop greater tolerance for discomfort while simultaneously decreasing the stress-related physiological activation that can exacerbate gastrointestinal symptoms.

Research involving patients with IBS has provided increasing support for mindfulness-based approaches. Mindfulness-based cognitive therapy has been shown to improve positive and negative emotions, sleep quality, and rumination among women with IBS, indicating that mindfulness can influence several psychological mechanisms implicated in symptom maintenance (Esmailzadeh Torshaye, 2025). In another study involving women with IBS, both mindfulness-based cognitive therapy and emotion-regulation training were examined in relation to resilience and self-compassion, with findings supporting the utility of mindfulness for enhancing adaptive psychological resources (Omidi et al., 2023). MBSR has also been directly compared with compassion-focused therapy among individuals with IBS and has demonstrated beneficial effects on cognitive emotion regulation (Pourkazem, 2023). Cognitive emotion regulation is highly relevant because maladaptive interpretations and repetitive negative thinking may intensify stress and gastrointestinal symptom perception, whereas more adaptive regulation may help individuals manage both illness-related distress and bodily discomfort.

The effects of MBSR may extend beyond psychological adaptation to the severity of gastrointestinal complaints themselves. Evidence indicates that MBSR can reduce the

severity of gastrointestinal symptoms among individuals with IBS, suggesting that mindfulness-related changes in stress reactivity and symptom appraisal may translate into observable clinical benefits (Pourkazem et al., 2024). Other research comparing mindfulness therapy with exposure-based psychological treatment has similarly shown reductions in symptom severity among patients with IBS (Nouri et al., 2023). Earlier work comparing mindfulness-based cognitive therapy with spiritual therapy also identified improvements in somatic symptoms among individuals with IBS (Asadollahi, 2013). Taken together, these findings are consistent with the broader biopsychosocial understanding of IBS, according to which changes in attention, emotional regulation, physiological stress activation, and interpretation of bodily sensations may influence both subjective symptom burden and daily functioning.

The possible effects of mindfulness interventions on somatization are also supported by research conducted in populations characterized by psychosomatic complaints. For instance, MBSR has been examined among students with psychosomatic symptoms and was associated with favorable changes in maladaptive psychological outcomes such as negative automatic thoughts and test anxiety (Ebadian & Moshtaghi, 2025). Such findings are important because negative automatic thoughts and heightened anxiety can amplify bodily vigilance and increase the perceived threat of physical sensations. In adolescents with IBS, reducing this cognitive-affective reactivity may help diminish the tendency for gastrointestinal discomfort to generalize into broader somatic distress. Mindfulness may consequently influence somatization through several interconnected pathways, including reductions in stress reactivity, decreased catastrophic appraisal, increased attentional flexibility, greater tolerance of unpleasant sensations, improved emotion regulation, and reduced automatic avoidance.

Evidence from chronic illness populations outside IBS further strengthens the rationale for using mindfulness-based interventions. A recent meta-analysis of mindfulness-based interventions in individuals with chronic illnesses found beneficial effects on depression, anxiety, and quality of life, indicating that mindfulness may improve psychological adjustment across varied medical conditions (Štánerová & Novotná, 2025). Randomized evidence has also shown that mindfulness-based treatment can be implemented effectively in adults with chronic physical illness, including rheumatoid arthritis, where it has been compared with cognitive behavioral therapy in a controlled design (Sharpe

et al., 2025). Although chronic illnesses differ substantially in pathophysiology and symptom expression, these findings are relevant because persistent physical symptoms often share common psychological challenges, including uncertainty, symptom monitoring, reduced perceived control, fear of exacerbation, and interference with everyday activities. Mindfulness may therefore represent a transdiagnostic approach capable of improving adaptation to recurrent or chronic physical symptoms.

Despite promising findings, several important gaps remain in the literature. First, much of the research on mindfulness and IBS has been conducted among adults, particularly women, whereas adolescent-specific intervention research remains comparatively limited. Adolescents differ from adults in cognitive development, emotion regulation, social context, dependency on family systems, and school-related functioning; therefore, treatment effects established in adult IBS samples cannot automatically be generalized to younger populations. Second, many mindfulness studies in adolescence have focused on general psychological distress, emotional regulation, rumination, or resilience without specifically examining adolescents coping with a disorder of gut–brain interaction. Conversely, many IBS intervention studies have emphasized gastrointestinal symptom severity or general psychological distress without simultaneously examining both a positive adaptive capacity such as psychological resilience and a maladaptive symptom-related outcome such as somatization. This distinction is important because effective psychological care should ideally not only reduce distress but also strengthen the resources that allow adolescents to manage future stressors more effectively.

A further gap concerns the durability of intervention effects. Immediate post-intervention improvements do not necessarily demonstrate that newly acquired mindfulness skills remain effective when adolescents encounter subsequent academic stress, family conflict, social pressure, or recurrence of gastrointestinal symptoms. Follow-up assessments are therefore essential for determining whether intervention-related gains in resilience and reductions in somatization persist beyond the active treatment period. Findings demonstrating improvements in resilience through adolescent mindfulness interventions (Mohammadpanah Ardakan et al., 2024; Navidi Moghadam, 2025), evidence linking mindfulness to adaptive functioning in adolescent clinical populations (Vo et al., 2024), and research showing beneficial effects of mindfulness-based approaches among patients with IBS (Esmaeilzadeh Torshaye, 2025; Omid

al., 2023; Pourkazem, 2023; Pourkazem et al., 2024) collectively suggest that an adolescent-focused MBSR intervention warrants systematic evaluation. Such work may be particularly relevant in clinical settings where medical treatment alone does not fully address the psychosocial burden associated with IBS.

From a developmental perspective, adolescence may also represent an advantageous period for preventive psychological intervention. Coping styles, emotional responses, health beliefs, and patterns of attention to bodily sensations are still developing during these years. Teaching mindfulness skills at this stage may therefore have effects extending beyond short-term symptom reduction by helping adolescents acquire more adaptive ways of responding to stress and recurrent physical discomfort. Resilience-building approaches have already been identified as important components of adolescent mental-health promotion (Llistosella et al., 2023), and associations among mindfulness, resilience, sleep, and emotional functioning suggest that these processes may operate as part of an interconnected adaptive system (Zhou et al., 2023). For adolescents with IBS, strengthening resilience while reducing somatic symptom burden may improve not only illness-related adjustment but also participation in school, social relationships, and everyday developmental activities.

Accordingly, there is a strong theoretical and empirical rationale for applying MBSR to adolescents with IBS. Existing studies suggest that mindfulness interventions can enhance resilience among adolescents (Akbarinejad & Naqizadeh Alamdari, 2023; Mohammadpanah Ardakan et al., 2024; Navidi Moghadam, 2025), improve adaptive psychological functioning in adolescent clinical populations (Vo et al., 2024), reduce psychosomatic distress (Ebadian & Moshtaghi, 2025), and improve psychological and gastrointestinal outcomes among patients with IBS (Asadollahi, 2013; Esmaeilzadeh Torshaye, 2025; Nouri et al., 2023; Omid et al., 2023; Pourkazem, 2023; Pourkazem et al., 2024). At the same time, epidemiological and clinical evidence demonstrates that IBS can significantly affect adolescents and may coexist with impaired school-related functioning and sleep difficulties (Cho et al., 2018; Kesuma et al., 2021; Yang, 2021). Evaluating an adolescent-adapted MBSR intervention may therefore contribute to a more comprehensive biopsychosocial treatment framework that addresses both the psychological resources necessary for adaptation and the somatic manifestations associated with stress and illness.

The aim of the present study was to determine the effectiveness of Mindfulness-Based Stress Reduction (MBSR) in improving psychological resilience and reducing somatic symptoms (somatization) among adolescents with irritable bowel syndrome (IBS).

2. Methods and Materials

2.1. Study Design and Participants

This study was conducted as a randomized controlled clinical study with a pretest–posttest design, a control group, and a three-month follow-up to investigate the effectiveness of Mindfulness-Based Stress Reduction (MBSR) on psychological resilience and somatic symptoms among adolescents diagnosed with irritable bowel syndrome (IBS). The statistical population consisted of adolescents aged 13–18 years with a confirmed diagnosis of IBS who attended pediatric gastroenterology clinics and specialized medical centers affiliated with universities of medical sciences in Tehran, Iran, during 2026. Participants were initially screened on the basis of medical records and clinical evaluation by a pediatric gastroenterologist according to the Rome IV diagnostic criteria for IBS. A total of 40 eligible adolescents were recruited through purposive sampling and, after completion of baseline assessments, were randomly allocated in equal proportions to the MBSR intervention group ($n = 20$) and the control group ($n = 20$) using a computer-generated randomization sequence. The inclusion criteria were being between 13 and 18 years of age, fulfillment of the Rome IV diagnostic criteria for IBS as confirmed by a gastroenterologist, experiencing IBS symptoms for at least six months, ability to read and write Persian, willingness to participate in the study, provision of written informed assent by the adolescent and written informed consent by a parent or legal guardian, and absence of concurrent participation in another psychological intervention. The exclusion criteria included diagnosis of inflammatory bowel disease, celiac disease, or another major organic gastrointestinal disorder; presence of a severe neurological or psychiatric disorder requiring immediate specialized treatment; initiation or major alteration of psychotropic or gastrointestinal medication during the intervention period; absence from more than two MBSR sessions; failure to complete the study questionnaires; and withdrawal of consent during the study. Participants in both groups continued to receive their routine medical care, while those assigned to the control group did not receive a structured psychological intervention during the study

period. Assessments were conducted at three time points: before the intervention, immediately after completion of the eight-week intervention, and three months after the posttest assessment. Participants and their parents were informed about the purpose and procedures of the research, voluntary participation, confidentiality of personal information, and their right to discontinue participation at any stage without any consequences for their medical care. All collected information was coded and analyzed anonymously, and the research procedures were performed in accordance with established ethical principles for research involving human participants.

2.2. Measures

Demographic and Clinical Information Form. A researcher-developed demographic and clinical information form was used to record participants' background characteristics and relevant clinical information. The form included age, gender, educational grade, duration of IBS symptoms, predominant IBS subtype, history of gastrointestinal treatment, medication use, previous psychological treatment, and selected family and medical characteristics. Clinical information regarding the diagnosis and duration of IBS was additionally checked against available medical records and the assessment performed by the treating gastroenterologist. The information obtained through this form was used to describe the study sample and assess the comparability of the intervention and control groups at baseline.

Connor–Davidson Resilience Scale (CD-RISC). Psychological resilience was assessed using the Connor–Davidson Resilience Scale developed by Connor and Davidson in 2003. The original scale consists of 25 items designed to evaluate an individual's ability to cope effectively with adversity, stressful circumstances, change, and psychological pressure. Items are rated on a five-point Likert scale ranging from 0 (not true at all) to 4 (true nearly all of the time), resulting in a total score ranging from 0 to 100. Higher scores represent greater psychological resilience and a stronger capacity to adapt successfully to stressful or challenging experiences. The scale encompasses important aspects of resilience, including perceived competence and tenacity, tolerance of negative affect and strengthening effects of stress, positive acceptance of change and secure relationships, perceived control, and spiritual influences. The CD-RISC has been extensively used among adolescent and adult populations and has demonstrated satisfactory

psychometric characteristics across clinical and nonclinical samples. Previous studies have supported its construct validity, convergent validity, internal consistency, and test-retest reliability, with Cronbach's alpha coefficients generally indicating high internal consistency. The Persian version of the CD-RISC has also demonstrated acceptable validity and reliability and has been widely used in psychological and health-related research in Iran. In the present study, the total CD-RISC score was considered the primary indicator of psychological resilience, with higher post-intervention scores indicating greater resilience.

Children's Somatization Inventory-24 (CSI-24). Somatic symptoms were assessed using the Children's Somatization Inventory-24, a shortened version of the Children's Somatization Inventory developed for the assessment of nonspecific somatic complaints in children and adolescents and psychometrically refined by Walker and colleagues. The CSI-24 consists of 24 items assessing the extent to which a child or adolescent has experienced a variety of physical symptoms, including gastrointestinal complaints, headaches, dizziness, fatigue, musculoskeletal discomfort, cardiopulmonary sensations, and other bodily symptoms that commonly accompany psychological distress or functional somatic syndromes. Respondents indicate how much they have been bothered by each symptom during the specified recent period using a five-point response scale ranging from 0 (not at all) to 4 (a whole lot). Item scores are summed to generate a total somatization score, with higher scores indicating greater frequency or severity of somatic symptoms. The CSI-24 is particularly appropriate for pediatric populations and has been frequently used in studies involving functional abdominal pain and other disorders of gut-brain interaction. Previous psychometric investigations have demonstrated satisfactory internal consistency, construct validity, convergent validity, and sensitivity to differences in symptom severity among children and adolescents with functional somatic conditions. The questionnaire has also shown meaningful associations with functional disability, emotional distress, and gastrointestinal symptom burden. In the present study, the total CSI-24 score was used as the indicator of somatization, with reductions in scores following treatment reflecting improvement in somatic symptom burden.

2.3. Intervention

Participants assigned to the intervention group received an adapted Mindfulness-Based Stress Reduction program

based on the principles of the MBSR protocol originally developed by Jon Kabat-Zinn, with the exercises and discussions adjusted to the developmental characteristics of adolescents and the clinical context of IBS. The intervention consisted of eight weekly group sessions, each lasting approximately 90 minutes, delivered by a trained therapist experienced in mindfulness-based interventions with adolescents. The first session introduced the concept of mindfulness, the relationship among stress, emotions, physiological arousal, and gastrointestinal symptoms, and the practice of mindful breathing. The second session focused on body awareness through body-scan meditation and recognition of bodily sensations without judgment or avoidance. The third session introduced mindful movement and gentle stretching and emphasized awareness of automatic reactions to stressful experiences. The fourth session addressed the identification of stressful thoughts and emotions, nonjudgmental observation of internal experiences, and the use of mindfulness in responding to discomfort and abdominal symptoms. The fifth session focused on acceptance, decentering from distressing thoughts, and developing a different relationship with pain, gastrointestinal discomfort, and unpleasant bodily sensations rather than attempting to suppress them. The sixth session emphasized mindful emotion regulation, awareness of interpersonal stress, and the application of mindfulness to difficult daily situations. The seventh session integrated sitting meditation, mindful breathing, body awareness, and self-directed mindfulness practices and encouraged participants to identify individualized strategies for incorporating mindfulness into school, family, and social contexts. The eighth session reviewed skills learned throughout the program, discussed relapse prevention and maintenance of regular mindfulness practice, and developed an individualized plan for continuing the techniques after treatment termination. Participants were also asked to complete approximately 20–30 minutes of home mindfulness practice on most days of the week and to record their practice in brief homework logs. The therapist reviewed adherence and potential difficulties at the beginning of each subsequent session. The control group received routine medical care and did not participate in any structured mindfulness or psychological intervention during the eight-week study period. To minimize contamination, participants in the two groups attended assessments separately and were requested not to share intervention materials during the study.

2.4. Data Analysis

Data were analyzed using IBM SPSS Statistics. Before inferential analyses, the dataset was examined for missing values, data-entry errors, outliers, and the distributional characteristics of the study variables. Descriptive statistics, including mean, standard deviation, frequency, and percentage, were calculated to summarize participants' demographic and clinical characteristics and scores on psychological resilience and somatization at the pretest, posttest, and three-month follow-up assessments. Baseline equivalence between the intervention and control groups was examined for relevant demographic and outcome variables. The assumptions required for parametric analyses were evaluated before hypothesis testing, including normality of score distributions, homogeneity of variances, and relevant assumptions concerning the covariance structure of repeated measurements. To determine the effectiveness of MBSR and evaluate whether changes in psychological resilience and somatization differed between the two groups across the three assessment occasions, repeated-measures multivariate analysis of variance was performed with group as the between-subjects factor and time as the within-subjects factor. Where appropriate, univariate follow-up analyses and pairwise comparisons with adjustment for multiple comparisons were conducted to determine the location and persistence of significant changes from pretest to posttest and follow-up. Effect sizes were reported using partial eta squared to indicate the magnitude of intervention effects. Statistical tests were performed using a two-tailed significance level of $p < .05$, and the three-month follow-up assessment was used to determine whether

improvements observed immediately after the intervention were maintained over time.

3. Findings and Results

A total of 40 adolescents with irritable bowel syndrome completed the study and were included in the final analyses, with 20 participants in the Mindfulness-Based Stress Reduction (MBSR) group and 20 participants in the control group. The mean age of the participants was 15.48 ± 1.54 years, with an age range of 13 to 18 years. In the MBSR group, the mean age was 15.55 ± 1.50 years, whereas the corresponding value in the control group was 15.40 ± 1.61 years. Of the total participants, 23 adolescents (57.5%) were female and 17 (42.5%) were male. The intervention group consisted of 12 females (60.0%) and 8 males (40.0%), while the control group included 11 females (55.0%) and 9 males (45.0%). Regarding educational level, 13 participants (32.5%) were studying in grades 7–9 and 27 (67.5%) were studying in grades 10–12. The mean duration of IBS symptoms was 2.63 ± 1.19 years in the MBSR group and 2.51 ± 1.24 years in the control group. With respect to IBS subtype, 13 participants (32.5%) had IBS with predominant constipation, 11 (27.5%) had IBS with predominant diarrhea, 10 (25.0%) had mixed IBS, and 6 (15.0%) had unclassified IBS. Examination of baseline demographic and clinical characteristics indicated no statistically significant differences between the two groups in age, gender distribution, educational level, duration of IBS, or IBS subtype ($p > .05$), indicating satisfactory comparability between the intervention and control groups before implementation of the intervention.

Table 1

Descriptive statistics for psychological resilience and somatization across the three measurement occasions

Variable	Group	Pretest Mean $\pm$ SD	Posttest Mean $\pm$ SD	Follow-up Mean $\pm$ SD
Psychological resilience	MBSR	48.65 $\pm$ 7.84	64.90 $\pm$ 7.21	63.35 $\pm$ 7.46
Psychological resilience	Control	49.20 $\pm$ 8.02	50.15 $\pm$ 7.91	49.75 $\pm$ 8.13
Somatization	MBSR	43.80 $\pm$ 8.36	28.65 $\pm$ 7.42	30.10 $\pm$ 7.68
Somatization	Control	42.95 $\pm$ 8.18	41.90 $\pm$ 8.25	42.25 $\pm$ 8.31

As shown in Table 1, the two groups had relatively similar mean scores for both study variables at the pretest assessment. Psychological resilience in the MBSR group increased substantially from 48.65 ± 7.84 at pretest to 64.90 ± 7.21 immediately after the intervention and remained relatively high at the three-month follow-up, with a mean score of 63.35 ± 7.46 . This pattern represents an increase of

16.25 points from pretest to posttest and an increase of 14.70 points from pretest to follow-up. Although a slight reduction in resilience was observed between posttest and follow-up, the follow-up mean remained considerably higher than the baseline value. In contrast, the control group demonstrated only minimal changes in psychological resilience, with mean scores of 49.20 ± 8.02 at pretest, 50.15 ± 7.91 at

posttest, and 49.75 ± 8.13 at follow-up. A similarly distinct pattern was observed for somatization. The mean somatization score in the MBSR group decreased from 43.80 ± 8.36 at baseline to 28.65 ± 7.42 at posttest and remained low at follow-up, with a mean of 30.10 ± 7.68 . Thus, the intervention group exhibited a reduction of 15.15 points from pretest to posttest and 13.70 points from pretest to follow-up. In comparison, the control group's somatization scores remained largely stable across the study period, changing from 42.95 ± 8.18 at pretest to 41.90 ± 8.25 at posttest and 42.25 ± 8.31 at follow-up. The descriptive pattern therefore suggested that MBSR was associated with a substantial increase in psychological resilience and a marked reduction in somatic symptoms, with most of the observed improvements maintained three months after completion of the intervention.

Before conducting the main inferential analyses, the statistical assumptions required for repeated-measures

analysis were examined. Inspection of skewness and kurtosis indices and assessment of score distributions indicated no substantial deviations from normality for psychological resilience or somatization across groups and measurement occasions. Levene's tests for equality of error variances were nonsignificant for both dependent variables at the three assessment points ($p > .05$), supporting homogeneity of variance between the groups. Furthermore, Box's M test did not indicate a significant violation of the equality of covariance matrices ($p > .05$). Mauchly's test of sphericity was nonsignificant for psychological resilience but significant for somatization; therefore, the Greenhouse–Geisser correction was applied to the within-subject tests for somatization. Taken together, these findings supported proceeding with repeated-measures multivariate and univariate analyses.

Table 2

Repeated-measures analysis of variance for the effects of time, group, and time $\times$ group interaction on psychological resilience and somatization

Variable	Effect	df	F	p	Partial η^2
Psychological resilience	Time	2, 76	46.82	< .001	.552
Psychological resilience	Group	1, 38	18.64	< .001	.329
Psychological resilience	Time $\times$ Group	2, 76	38.57	< .001	.504
Somatization	Time	1.74, 66.12	51.36	< .001	.575
Somatization	Group	1, 38	16.92	< .001	.308
Somatization	Time $\times$ Group	1.74, 66.12	43.21	< .001	.532

The results presented in Table 2 demonstrate statistically significant changes in both psychological resilience and somatization over time. For psychological resilience, the main effect of time was significant, $F(2, 76) = 46.82$, $p < .001$, partial $\eta^2 = .552$, indicating that resilience scores changed significantly across pretest, posttest, and follow-up assessments irrespective of group membership. The main effect of group was also significant, $F(1, 38) = 18.64$, $p < .001$, partial $\eta^2 = .329$, indicating an overall difference in resilience scores between adolescents receiving MBSR and those in the control group. More importantly, the time $\times$ group interaction was statistically significant, $F(2, 76) = 38.57$, $p < .001$, partial $\eta^2 = .504$. This interaction indicates that changes in psychological resilience over time differed substantially between the two groups and that the improvement observed in the MBSR group could not be attributed merely to the passage of time. The partial eta-squared value of .504 indicates a large intervention-related

effect, with approximately 50.4% of the variance in changes in resilience scores associated with the interaction between intervention condition and measurement time.

For somatization, the Greenhouse–Geisser-adjusted analysis similarly revealed a significant main effect of time, $F(1.74, 66.12) = 51.36$, $p < .001$, partial $\eta^2 = .575$, showing substantial changes in somatic symptom scores across the three assessment occasions. The main effect of group was statistically significant, $F(1, 38) = 16.92$, $p < .001$, partial $\eta^2 = .308$, indicating an overall difference between the MBSR and control groups. Most importantly, the interaction between time and group was significant, $F(1.74, 66.12) = 43.21$, $p < .001$, partial $\eta^2 = .532$. This result demonstrates that the trajectory of somatization differed markedly between the groups, with the MBSR group showing a pronounced reduction in somatic symptoms following treatment, whereas scores in the control group remained comparatively stable. The interaction effect size of .532 was

large and indicated that 53.2% of the variance in changes in somatization was attributable to the differential pattern of change between the MBSR and control groups. Collectively, the interaction effects for both dependent variables provide

strong statistical evidence that MBSR was effective in increasing psychological resilience and reducing somatic symptom severity among adolescents with IBS.

Table 3

Bonferroni-adjusted pairwise comparisons across measurement occasions in the MBSR group

Variable	Comparison	Mean Difference	SE	p	95% CI
Psychological resilience	Pretest vs. Posttest	-16.25	1.74	< .001	-20.73 to -11.77
Psychological resilience	Pretest vs. Follow-up	-14.70	1.81	< .001	-19.36 to -10.04
Psychological resilience	Posttest vs. Follow-up	1.55	0.84	.214	-0.61 to 3.71
Somatization	Pretest vs. Posttest	15.15	1.69	< .001	10.80 to 19.50
Somatization	Pretest vs. Follow-up	13.70	1.76	< .001	9.17 to 18.23
Somatization	Posttest vs. Follow-up	-1.45	0.79	.226	-3.49 to 0.59

The Bonferroni-adjusted pairwise comparisons shown in Table 3 further clarified the pattern of change within the MBSR group. Psychological resilience increased significantly from pretest to posttest, with a mean difference of 16.25 points, $p < .001$, and the difference between pretest and follow-up also remained statistically significant, with a mean difference of 14.70 points, $p < .001$. In contrast, the difference between posttest and follow-up was not statistically significant, $p = .214$, demonstrating that the increase in psychological resilience obtained immediately after the MBSR intervention was largely maintained during the subsequent three-month period. Although resilience scores decreased slightly from posttest to follow-up, the magnitude of this change was small and statistically nonsignificant. This pattern suggests maintenance rather than loss of treatment gains.

A parallel pattern was observed for somatization. Somatic symptom scores were significantly lower at posttest than at pretest, with a mean reduction of 15.15 points, $p < .001$. The difference between pretest and follow-up was also statistically significant, with somatization scores at follow-up remaining 13.70 points lower than baseline, $p < .001$. The comparison between posttest and follow-up was not statistically significant, $p = .226$, indicating that the modest increase in somatic symptoms observed during the three months following treatment did not represent a statistically meaningful deterioration. Thus, the symptom reduction achieved immediately after the intervention was predominantly sustained at follow-up. In contrast, supplementary pairwise examinations within the control group revealed no significant differences between pretest, posttest, and follow-up scores for either psychological resilience or somatization (all $p > .05$), further supporting the

conclusion that the observed improvements were specifically associated with participation in the MBSR program rather than repeated assessment, spontaneous recovery, or routine medical care alone.

Overall, the findings indicated a consistent and clinically meaningful pattern in favor of MBSR. Adolescents who participated in the eight-session mindfulness-based program demonstrated substantial improvements in psychological resilience and substantial reductions in somatic symptom severity relative to adolescents receiving routine care alone. The statistically significant time $\times$ group interactions, large partial eta-squared values, and maintenance of gains at the three-month follow-up collectively supported the effectiveness and relative durability of the intervention. Therefore, the study hypotheses that MBSR would increase psychological resilience and reduce somatization among adolescents with IBS were supported.

4. Discussion

The present study investigated the effectiveness of Mindfulness-Based Stress Reduction (MBSR) in improving psychological resilience and reducing somatic symptoms among adolescents with irritable bowel syndrome (IBS). The findings showed that adolescents who received the eight-session MBSR intervention demonstrated a significant increase in psychological resilience from pretest to posttest, and this improvement was maintained at the three-month follow-up. In contrast, the control group showed only minimal changes across the three assessment occasions. The time $\times$ group interaction for psychological resilience was statistically significant and associated with a large effect size, indicating that the observed improvement was attributable to the intervention rather than merely to the

passage of time or repeated measurement. The findings also showed a significant reduction in somatization among adolescents in the MBSR group. Somatic symptom scores decreased substantially from pretest to posttest and remained significantly lower than baseline at follow-up, whereas the control group showed no meaningful change. The large interaction effect for somatization further demonstrated that MBSR produced a clinically relevant change in the pattern of physical symptom reporting over time. Overall, the findings support the effectiveness of MBSR as a psychological intervention capable of simultaneously strengthening an adaptive psychological resource, namely resilience, and reducing maladaptive somatic symptom burden in adolescents with IBS.

The finding that MBSR significantly improved psychological resilience is consistent with previous research showing that mindfulness-based interventions can enhance adaptive psychological capacities during adolescence. Navidi Moghadam reported that mindfulness training was effective in improving resilience and emotional regulation among adolescents, suggesting that mindfulness practice may increase adolescents' capacity to cope with stressful experiences without becoming overwhelmed by them (Navidi Moghadam, 2025). Similarly, Mohammadpanah Ardakan and colleagues found that mindfulness-based cognitive therapy improved resilience in adolescents while also producing favorable changes in rumination and sleep quality (Mohammadpanah Ardakan et al., 2024). These findings are consistent with the present results because adolescents with IBS frequently encounter recurrent and unpredictable bodily discomfort, restrictions in school and social functioning, and uncertainty regarding symptom occurrence. Under such circumstances, resilience is particularly important because it allows adolescents to respond to persistent health-related stress with flexibility, persistence, and adaptive coping rather than helplessness or avoidance.

The present findings are also in line with evidence showing that mindfulness-based approaches can improve resilience in adolescents with chronic physical health conditions. Akbarinejad and Naqizadeh Alamdari reported that mindfulness-based cognitive therapy was effective in enhancing resilience and quality of life among adolescent girls with heart disease (Akbarinejad & Naqizadeh Alamdari, 2023). Although cardiac disease and IBS differ markedly in their biological mechanisms, both can create chronic uncertainty, repeated physical symptoms, interference with normal developmental activities, and

heightened concern regarding bodily experiences. Mindfulness may therefore operate through common psychological mechanisms across chronic or recurrent health conditions. By teaching adolescents to observe unpleasant sensations, thoughts, and emotions without immediate judgment, mindfulness may reduce automatic emotional reactivity and increase perceived ability to remain psychologically stable in the presence of stress. This capacity is central to resilience and may explain why the MBSR participants in the present study showed substantial and sustained increases in resilience scores.

The results are further supported by the study of Vo and colleagues, who examined a mindfulness-based intervention designed for adolescents in a heterogeneous clinical population and reported improvements in mindful awareness and resilience-related capacities (Vo et al., 2024). Their findings suggest that mindfulness programs are feasible and potentially effective even among adolescents experiencing diverse psychological and health-related difficulties. The present findings extend this evidence specifically to adolescents with IBS and suggest that mindfulness skills may be particularly useful when stress is closely linked to physical symptom perception. IBS symptoms are frequently unpredictable and can occur in contexts that adolescents perceive as socially threatening, such as school, examinations, transportation, or peer interactions. Developing the ability to notice internal experiences without immediately interpreting them as uncontrollable threats may increase the adolescent's sense of competence and psychological stability.

The association between mindfulness and resilience is also consistent with the findings reported by Zhou and colleagues, who found that low mindfulness was related to poorer sleep quality through processes involving reduced resilience and emotional dysfunction from middle adolescence to emerging adulthood (Zhou et al., 2023). This relationship indicates that resilience may constitute an important psychological pathway through which mindfulness influences broader health and adjustment outcomes. Kapoor and colleagues likewise identified meaningful relationships involving mindfulness and resilience in adolescent populations (Kapoor et al., 2024). From this perspective, MBSR may enhance resilience by increasing emotional awareness, attentional control, acceptance of internal experiences, and the capacity to respond deliberately rather than react automatically. Adolescents who become more skilled at recognizing bodily discomfort and emotional activation without catastrophizing

these experiences may perceive themselves as more capable of coping with IBS symptoms and other life stressors.

The significant improvement in resilience can also be interpreted within a developmental framework. Adolescence is characterized by rapid changes in emotional regulation, social relationships, identity formation, academic expectations, and autonomy. The presence of a chronic functional gastrointestinal disorder can disrupt these developmental processes and increase vulnerability to psychological distress. Programs aimed at fostering resilience have therefore been emphasized as an important component of adolescent mental-health promotion. Llistosella and colleagues highlighted the importance of structured interventions designed to strengthen resilience among adolescents at risk (Llistosella et al., 2023). MBSR may serve a similar protective function by helping adolescents develop a more flexible and less reactive relationship with stress. Rather than attempting to eliminate all discomfort, adolescents learn that difficult internal states can be observed and tolerated without necessarily determining behavior. Such learning may foster a broader sense of psychological competence and adaptability.

The second major finding of the present study was that MBSR significantly reduced somatization among adolescents with IBS. This result is consistent with previous evidence showing beneficial effects of mindfulness-based interventions on somatic and gastrointestinal symptoms. Asadollahi found that mindfulness-based cognitive therapy reduced somatic symptoms, anxiety, and depression among patients with IBS (Asadollahi, 2013). Similarly, Nouri and colleagues reported that mindfulness therapy reduced symptom severity in patients with IBS (Nouri et al., 2023). Pourkazem and colleagues also found that MBSR was effective in reducing the severity of gastrointestinal symptoms among individuals with IBS (Pourkazem et al., 2024). The consistency of these findings suggests that mindfulness-based treatment may affect not only psychological distress but also the subjective experience and reporting of physical symptoms associated with disorders of gut–brain interaction.

One mechanism that may explain the reduction in somatization is decreased hypervigilance toward bodily sensations. Adolescents with IBS may become highly attentive to gastrointestinal changes because they anticipate abdominal pain, bowel urgency, bloating, or embarrassment in social and school situations. This heightened monitoring can increase the salience of relatively minor bodily sensations and reinforce the perception that such sensations

are threatening. MBSR trains individuals to attend deliberately to present-moment bodily experience while adopting a nonjudgmental and accepting stance. The purpose is not to ignore physical sensations but to experience them without immediately labeling them as dangerous or intolerable. Over repeated practice, this process may reduce the tendency to catastrophize somatic sensations and decrease the amplification of bodily distress. The reduction in somatization observed in the present study may therefore reflect a shift in the way participants perceived and interpreted their physical experiences.

Another potential mechanism is improved regulation of stress-related emotional responses. Stress can influence gastrointestinal functioning through autonomic, neuroendocrine, and behavioral pathways, and psychological distress may exacerbate IBS symptoms. Mindfulness-based interventions encourage recognition of stress responses as they arise and promote a less reactive response to negative emotions. Pourkazem demonstrated that MBSR improved cognitive emotion regulation in patients with IBS (Pourkazem, 2023). Likewise, Omid and colleagues found beneficial effects of mindfulness-based cognitive therapy on resilience and self-compassion among women with IBS (Omid et al., 2023). These psychological changes may reduce emotional arousal and thereby interrupt the reciprocal cycle through which distress increases gastrointestinal symptoms and worsening symptoms generate further distress. In adolescents, whose emotion-regulation capacities are still developing, this mechanism may be particularly important.

The findings are also consistent with Esmaeilzadeh Torshaye, who reported that mindfulness-based cognitive therapy improved positive and negative emotions, sleep quality, and rumination in women with IBS (Esmaeilzadeh Torshaye, 2025). Rumination and persistent negative thinking can maintain physiological arousal and increase attention to bodily discomfort. By reducing repetitive negative thinking and increasing present-moment awareness, mindfulness may decrease the cognitive processes that contribute to the persistence of somatic distress. This interpretation is particularly relevant to adolescents, who may respond to recurrent IBS symptoms with repeated worry about school attendance, embarrassment, peer judgment, or future symptom episodes. Mindfulness may weaken these repetitive cognitive patterns and thereby reduce both emotional distress and somatic symptom amplification.

The present findings regarding somatization are additionally supported by Ebadian and Moshtaghi, who found that MBSR produced improvements in negative automatic thoughts and test anxiety among individuals with psychosomatic symptoms (Ebadian & Moshtaghi, 2025). Although that study examined a different population, the results suggest that MBSR can modify cognitive-affective processes underlying psychosomatic complaints. Negative automatic thoughts can intensify bodily distress by framing physical sensations as evidence of danger, incapacity, or loss of control. MBSR may reduce the influence of such cognitions by teaching participants to regard thoughts as transient mental events rather than objective facts. In adolescents with IBS, this decentered stance may help reduce beliefs such as expecting symptoms to become unbearable or assuming that abdominal discomfort will inevitably lead to social embarrassment. As these interpretations weaken, somatic symptom burden may also decrease.

The significant effects observed in the present study are also compatible with broader evidence concerning mindfulness-based interventions in chronic illness. Štánerová and Novotná found in their meta-analysis that mindfulness-based interventions improved depression, anxiety, and quality of life among individuals living with chronic medical conditions (Štánerová & Novotná, 2025). Sharpe and colleagues also demonstrated the utility of mindfulness-based treatment in a randomized controlled trial involving individuals with rheumatoid arthritis (Sharpe et al., 2025). These studies suggest that mindfulness may have transdiagnostic relevance across chronic physical conditions because many such disorders involve recurring symptoms, perceived lack of control, uncertainty, emotional distress, and disruption of everyday functioning. The present study extends this broader literature by showing that mindfulness may also improve adaptive functioning and reduce somatic distress among adolescents with a functional gastrointestinal disorder.

The adolescent-specific context is important when interpreting these results. IBS can interfere with school life, sleep, social relationships, and routine activities. Cho and colleagues demonstrated that adolescents with IBS may experience impaired quality of school life, highlighting the functional consequences of the disorder beyond gastrointestinal symptoms (Cho et al., 2018). Yang also reported an association between insomnia and IBS among adolescents, indicating that IBS may be linked to broader disturbances in health and psychological functioning (Yang,

2021). Kesuma and colleagues documented the occurrence and clinical relevance of IBS among adolescents, emphasizing that the disorder should be recognized as an important pediatric health concern (Kesuma et al., 2021). These findings help contextualize the benefits of MBSR observed in the present study. An intervention that both increases resilience and reduces somatic distress may provide adolescents with greater capacity to remain engaged in education, peer relationships, and everyday activities despite the recurrent nature of IBS.

An important feature of the present findings was the maintenance of treatment effects at the three-month follow-up. Psychological resilience remained significantly higher than baseline, and somatization remained significantly lower, while the small changes from posttest to follow-up were not statistically significant. This suggests that the intervention may have produced skills that participants could continue to apply after formal sessions ended. Mindfulness differs from interventions based solely on therapist-delivered techniques because participants are taught practices that can be independently integrated into daily life, such as mindful breathing, body awareness, and nonjudgmental observation of thoughts and emotions. Continued use of these strategies may help explain the durability of treatment gains. The finding is particularly meaningful in IBS because symptoms often fluctuate over time, and effective management requires skills that remain available when stress or gastrointestinal discomfort reemerges.

5. Conclusion

Taken together, the results indicate that MBSR may exert its effects through interconnected cognitive, emotional, and physiological pathways. Mindfulness practice can increase awareness of internal experience while reducing automatic judgment, which may decrease catastrophic interpretation of bodily sensations. It may simultaneously improve emotional regulation and reduce repetitive negative thinking, thereby lowering stress-related arousal. These changes may strengthen resilience by enhancing the adolescent's perceived capacity to tolerate and adapt to difficult experiences. At the same time, reduced physiological and cognitive reactivity may decrease the amplification of gastrointestinal and other bodily symptoms. The simultaneous increase in resilience and reduction in somatization observed in the present study therefore appears

theoretically coherent and consistent with existing research on mindfulness, adolescence, chronic illness, and IBS.

6. Limitations & Suggestions

Several limitations should be considered when interpreting the findings of this study. The relatively small sample size of 40 adolescents may restrict the statistical power and generalizability of the results to the broader population of adolescents with IBS. Participants were recruited from clinical settings in Tehran, and therefore the findings may not necessarily represent adolescents living in other geographical, cultural, or socioeconomic contexts. The outcomes were primarily assessed using self-report questionnaires, which may be affected by response tendencies, recall error, social desirability, or participants' expectations regarding treatment. In addition, the control group received routine care rather than an active psychological intervention, meaning that nonspecific factors such as therapist attention, group interaction, treatment expectations, and perceived social support cannot be completely separated from the specific effects of MBSR. The three-month follow-up period, although useful for evaluating short-term maintenance, does not establish whether treatment effects persist over longer periods. Finally, the study did not directly assess potential mediating mechanisms such as mindfulness level, emotion regulation, catastrophizing, perceived stress, or gastrointestinal-specific anxiety, which limits conclusions regarding the processes responsible for the observed effects.

Future studies should replicate the present research with larger and more diverse samples recruited from multiple clinical centers and different geographical regions to improve external validity. Randomized trials with active comparison groups, such as cognitive-behavioral therapy, stress-management education, supportive group therapy, or relaxation training, would provide stronger evidence regarding the specific effects of MBSR. Longer follow-up periods of six months or one year should be used to determine the durability of changes in resilience and somatization. Future research could also examine whether treatment effects differ according to age, gender, IBS subtype, duration of illness, baseline symptom severity, or psychiatric comorbidity. Including objective or clinician-rated indicators alongside self-report scales would provide a more comprehensive assessment of treatment outcomes. Studies should additionally evaluate possible mediators such as mindfulness skills, gastrointestinal-specific anxiety,

emotion regulation, catastrophizing, perceived stress, sleep quality, self-compassion, and autonomic regulation to clarify the mechanisms through which MBSR influences psychological and somatic outcomes. Research comparing face-to-face, online, individual, and group-based formats may also identify more accessible methods for delivering mindfulness interventions to adolescents.

The findings suggest that MBSR can be considered as an adjunctive psychological intervention within multidisciplinary care for adolescents with IBS. Pediatric gastroenterology clinics, adolescent health services, and psychological treatment centers may benefit from incorporating developmentally adapted mindfulness programs alongside routine medical management. Clinicians should explain that mindfulness is not intended to deny or minimize genuine gastrointestinal symptoms but rather to help adolescents respond to stress, physical discomfort, and illness-related thoughts in a more regulated and adaptive manner. Short mindfulness practices can be integrated into daily routines at home and at school, and parents may be provided with basic guidance regarding how to support regular practice without placing excessive pressure on the adolescent. Health professionals should also consider screening adolescents with IBS for low resilience, excessive somatic concern, stress, sleep problems, and functional impairment, as these factors may identify individuals who could particularly benefit from psychological intervention. Coordination among pediatric gastroenterologists, psychologists, school counselors, and families may increase treatment adherence and facilitate the translation of mindfulness skills into everyday academic, family, and social situations.

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Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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Authors' Contributions

All authors equally contributed to this article.

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