



Structural modeling of IBS severity: the mediating role of negative meta-emotions in stress, hostile attribution, and cognitive bias – a cross-sectional study

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Background: Irritable bowel syndrome (IBS) is one of the most prevalent gastrointestinal disorders, significantly affecting the quality of life of patients. Recent research indicates that psychological factors, such as stress and hostile attribution, can exacerbate the severity of IBS symptoms. This study aims to explore the structural relationships among IBS symptom severity, hostile attribution, perceived stress, and cognitive bias, with a mediating role of negative meta-emotions.

Methods: This descriptive-correlational, cross-sectional study was conducted on 300 adults diagnosed with IBS in Tabriz. Data were collected using validated questionnaires, including the Hostile Attribution Scale, the Perceived Stress Scale, the Negative Meta-Emotion Questionnaire, and the Cognitive Bias Scale. Data was analyzed using SPSS software and Structural Equation Modeling (SEM) in AMOS software.

Results: The findings revealed that perceived stress and hostile attribution significantly influenced cognitive biases ($P < 0.01$). Furthermore, negative meta-emotions acted as a mediating variable in these relationships and had a positive and significant impact on IBS symptom severity. SEM analysis indicated that the overall effect of perceived stress on cognitive bias was 0.55, while the impact of hostile attribution was 0.49. These results underscore the crucial role of negative meta-emotions in enhancing the relationships among the studied variables.

Conclusion: This study highlights the importance of negative meta-emotions as key mediators in explaining IBS symptoms. The obtained results can assist in designing effective psychological interventions for managing IBS symptoms. Addressing psychological factors and negative meta-emotions in the treatment of this disorder may lead to improvements in patient's quality of life and reductions in the severity of their symptoms. Future research should focus on investigating targeted interventions in this area and conducting longitudinal analyses.

Keywords: cognitive bias, hostile attribution, irritable bowel syndrome, negative meta-emotion, perceived stress

Introduction

Irritable Bowel Syndrome (IBS) is a prevalent gastrointestinal disorder that affects approximately 10–20% of the global population^[1]. Classified as a disorder of gut–brain interaction, IBS manifests through symptoms, such as abdominal pain, bloating, and alterations in bowel habits, which significantly impair the quality of life of those affected^[2]. Although the exact pathological causes of IBS remain unclear, growing evidence highlights the role

HIGHLIGHTS

- The study shows that negative meta-emotions significantly mediate the effects of perceived stress and hostile attribution on cognitive biases in IBS patients. Addressing these emotions in treatment can improve IBS symptoms and patients' quality of life.
- Perceived stress and hostile attribution greatly influence cognitive biases in IBS patients. This highlights the need for integrated psychological and medical treatments to manage IBS symptoms effectively.
- The study uses Structural Equation Modeling (SEM) to reveal complex relationships among stress, hostile attribution, negative meta-emotions, and cognitive biases in IBS. SEM findings emphasize the crucial mediating role of negative meta-emotions in these interactions.

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of psychological factors, particularly stress, in exacerbating the severity of IBS symptoms^[3].

One psychological mechanism implicated in IBS is hostile attribution, the tendency to interpret others' behaviors negatively. This trait not only fosters interpersonal tension but also heightens stress levels, potentially aggravating gastrointestinal symptoms^[4]. Moreover, individuals with a heightened propensity for hostile

attribution are more susceptible to stress, a vulnerability that is notably pronounced in IBS patients^[5].

Cognitive biases also play a critical role in the development and reinforcement of IBS symptoms. IBS patients often interpret environmental cues negatively in stressful situations, which can amplify anxiety and despair^[6]. Research has shown that these cognitive biases contribute to a negative feedback loop, further exacerbating the physical symptoms of IBS^[7].

Negative meta-emotions, such as anxiety and depression, have emerged as significant mediators between stress, hostile attribution, and IBS symptoms. These emotions not only increase an individual's stress response but also contribute to the intensification of physical symptoms^[8]. Several studies have reported that IBS patients experience higher levels and greater frequency of negative meta-emotions compared to the general population^[9].

Moreover, studies suggest that resilience, defined as the ability to adapt to stress and adversity, plays a vital role in moderating the effects of negative meta-emotions and enhancing the quality of life for IBS patients^[10]. Individuals with reduced resilience may struggle to cope with stress effectively, which in turn exacerbates the physical and psychological symptoms of IBS.

In recent years, researchers have increasingly turned to structural models to unravel the intricate relationships among hostile attribution, stress, and cognitive biases. These models highlight the complexity of the interactions between these psychological factors, emphasizing the need for a deeper understanding to develop more effective interventions^[11]. The application of structural models, particularly those exploring the mediating role of negative meta-emotions, contributes to a more comprehensive understanding of the dynamics at play in IBS^[12].

The novelty of this study lies in its comprehensive analysis of the complex psychological relationships among perceived stress, hostile attribution, negative meta-emotions, and cognitive biases in individuals with IBS. This research employs structural modeling to investigate the mediating role of negative meta-emotions, elucidating the significance of this variable in strengthening the connection between perceived stress and cognitive biases in this patient population – a perspective that has received limited attention in IBS research to date. Additionally, the study thoroughly examines the specific psychological correlations among perceived stress, hostile attribution tendencies, and cognitive biases, analyzing these variables as an integrated and influential set in Iranian patients with IBS for the first time. The findings not only enhance the understanding of the psychological dimensions of IBS but may also inform the design of targeted psychological interventions aimed at preventing the reinforcement of negative cognitive biases in IBS patients. Furthermore, this research opens avenues for new therapeutic interventions that, by gaining a more precise understanding of negative meta-emotions and their impacts, could contribute to improving the psychological well-being of patients.

This study aims to model the structural relationships between the severity of IBS symptoms, hostile attribution, perceived stress, and cognitive bias, with negative meta-emotions serving as a mediating variable. Through structural equation modeling, this research seeks to carefully examine the role and impact of each variable and provide recommendations for therapeutic and preventive interventions.

Method

This research employed a descriptive-correlational and cross-sectional design conducted in Tabriz County, East Azerbaijan Province. The target population consisted of all adults aged 18 to 60 years, who exhibited symptoms of IBS, identified according to the Rome IV criteria, a recognized and universal tool for diagnosing IBS. Inclusion criteria for the study were:^[1] a history of IBS symptoms for at least 3 months,^[2] the ability to read and write in Persian,^[3] no concurrent serious gastrointestinal or psychological disorders (such as bowel cancer or severe depression), and^[4] completion of a written consent form to participate in the study. It is noteworthy that the Rome IV criteria, serving as a definitive diagnostic tool, were applied based on clinical history and examination by physicians at specialized gastroenterology centers, and individuals were diagnosed using these precise criteria. Individuals with complex medical conditions or gastrointestinal symptoms attributable to pathological or infectious factors were excluded from the study. The work has been reported in line with the STROCSS criteria^[13].

Sample and sampling method

The sample size was calculated based on Cochran's formula with a significance level of 0.05 and a power of 0.80, resulting in a sample size of 300 participants. This study utilized a purposive sampling method, focusing on selecting patients with active treatment records at specialized gastroenterology centers in Tabriz. The sampling process involved several steps: first, a list of patients meeting the initial inclusion criteria was compiled in coordination with the managers and physicians of the treatment centers and gastroenterology clinics in the county. At this stage, gastroenterology specialists screened patients through medical record reviews and initial evaluations to identify eligible individuals. Four specialized gastroenterology treatment centers in Tabriz participated in this study, and the involvement of their physicians facilitated the patient selection process.

Measurement instruments

In this study, standardized and validated questionnaires were utilized to assess the variables. The measurement tools selected were directly relevant and appropriate for the study's objectives, with their validity and reliability confirmed in both international and Iranian research:

1. **Hostile Attribution Bias Questionnaire (SIP-HAB):** This tool assesses individuals' tendency to interpret others' behaviors as hostile. It has demonstrated good reliability and validity in international and local studies, including hypothetical scenarios where respondents are asked to interpret the behaviors of others. Higher scores indicate a greater inclination toward hostile attribution^[14,15].
2. **Perceived Stress Scale (PSS):** Developed by Cohen, this instrument measures individuals' stress levels and consists of 10 items, rated on a five-point Likert scale, with confirmed reliability and validity in the Iranian population. Higher scores reflect higher levels of perceived stress^[16].

3. **Negative Meta-Emotion Scale:** This tool evaluates negative emotions, such as anxiety and depression. It includes several subscales and provides a total score for negative meta-emotion. The high reliability of this instrument has been confirmed in local studies, with higher scores indicating elevated levels of negative emotions^[17].
4. **Cognitive Bias Questionnaire (Dacobes):** Comprising 42 items, this questionnaire assesses negative and irrational cognitive biases in various situations. A five-point Likert scale was used for responses, and its reliability and validity have also been affirmed in the Iranian context^[18].

Procedure

To enhance the accuracy and clarity of data collection, participants attended designated sessions at the gastroenterology clinics, where they completed the questionnaires in a calm environment, ensuring complete confidentiality. Each session lasted an average of 30 to 45 minutes, and each patient participated in a single session. The researcher was present during these sessions to address any potential questions from participants. Additionally, necessary arrangements were made with health-care centers to create a safe and non-stressful environment for patients, facilitating the execution of the process.

Statistical analysis

Data analysis was performed using SPSS and AMOS software to implement structural equation modeling (SEM). Initially, the data were assessed for normality using the Kolmogorov–Smirnov test. Subsequently, SEM was conducted to evaluate the mediating role of negative meta-emotions between stress, hostile attribution, and cognitive biases. For assessing mediation effects, both the bootstrap method and Baron and Kenny's approach were utilized to evaluate the indirect effects within the structural model.

Results

This section presents the results of the statistical analyses conducted in this study, focusing on the influence of perceived stress, hostile attribution, negative meta-emotions, and cognitive bias in patients with IBS. The objective of these analyses was to identify correlations and structural models among the variables, examining the direct and indirect effects of psychological factors on cognitive bias. The analyses include descriptive statistics, correlations, and the results of SEM to assess the mediating role of negative meta-emotions. Additionally, a bootstrapping analysis was performed to examine mediating effects and enhance the precision of relationships among the study variables.

As shown in Table 1, the results indicate that the mean perceived stress score among IBS patients is approximately 28.75, suggesting a relatively high level of stress in this group. Mean scores for hostile attribution and cognitive bias similarly reflect a tendency among patients toward negative interpretations and hostile perceptions.

As indicated in Table 2, the results show that perceived stress has a significant relationship with hostile attribution (0.45) and negative meta-emotions (0.60). Additionally, a strong correlation

Table 1

Descriptive statistics of the primary study variables

Variable	N	Mean (M)	Standard deviation (SD)	Range
Perceived stress	300	28.75	6.84	15–45
Hostile attribution	300	22.90	5.22	12–35
Negative meta-emotions	300	31.58	7.12	18–45
Cognitive bias	300	20.43	4.60	10–30

is observed between negative meta-emotions and cognitive bias (0.58), suggesting an important role for negative meta-emotions in reinforcing negative thinking patterns and cognitive biases.

As shown in Table 3, the SEM analysis indicates that negative meta-emotions play a strong mediating role between perceived stress and cognitive bias. The total effect of perceived stress on cognitive bias (0.55) and the total effect of hostile attribution on cognitive bias (0.49) demonstrate the direct and indirect influences of these variables through negative meta-emotions.

As shown in Table 4, the bootstrapping analysis results indicate that the indirect effects of perceived stress and hostile attribution on cognitive bias through negative meta-emotions are significant at the 0.001 level. The confidence intervals further confirm the existence of mediating effects in these relationships, underscoring the role of negative meta-emotions as a mediating variable.

Discussion

This study aimed to examine the mediating role of negative meta-emotions in the relationship between perceived stress, hostile attribution, and cognitive biases in patients with IBS. The results indicate that perceived stress and hostile attribution significantly impact cognitive biases in IBS patients, with negative meta-emotions, such as anxiety and depression, serving as an influential mediating factor. These findings align with prior research emphasizing the role of psychological factors in exacerbating IBS symptoms. For instance, Cohen, *et al* found that individuals experiencing higher stress levels tend to have more negative cognitive interpretations, which heightens sensitivity to gastrointestinal symptoms^[16].

Recent research also corroborates these findings, demonstrating that stress and hostile attribution affect IBS patients' cognitive processing by amplifying negative meta-emotions. In line with this, Miao *et al.* found that negative meta-emotions play a crucial mediating role between perceived stress and cognitive

Table 2

Correlations among study variables

Variable	Perceived stress	Hostile attribution	Negative meta-emotions	Cognitive bias
Perceived stress	1	0.45**	0.60**	0.42**
Hostile attribution	0.45**	1	0.53**	0.49**
Negative meta-emotions	0.60**	0.53**	1	0.58**
Cognitive bias	0.42**	0.49**	0.58**	1

Significance level: ** $P < 0.01$.

Table 3**Structural equation modeling (SEM) results for the mediating role of negative meta-emotions**

Path	Direct Effect	Indirect Effect (via Negative Meta-emotions)	Total Effect	Significance Level
Perceived Stress → Negative Meta-emotions	0.57	-	0.57	0.001
Perceived Stress → Cognitive Bias	0.22	0.33	0.55	0.001
Hostile Attribution → Negative Meta-emotions	0.49	-	0.49	0.001
Hostile Attribution → Cognitive Bias	0.21	0.28	0.49	0.001
Negative Meta-emotions → Cognitive Bias	0.56	-	0.56	0.001

biases, which directly influences the severity of both psychological and physical symptoms in IBS^[19]. Within the biopsychosocial model, these findings suggest that IBS symptoms are not solely physical but are significantly influenced by stress and negative emotional experiences.

Furthermore, this study reveals that individuals with higher levels of hostile attribution are potentially more prone to negative cognitive biases. This is consistent with similar studies, such as Quan *et al*, who identified a meaningful relationship between hostile attribution and negative thoughts or anger rumination^[20]. These studies suggest that hostile attribution may act as a risk factor, leading individuals to interpret others' behaviors more negatively, impacting not only mental health but also physical symptoms.

In addition, this study's results support cognitive-behavioral theories (CBT) and emotion regulation models that suggest enhancing patients' ability to recognize and modulate negative emotions could play an essential role in reducing cognitive biases and improving clinical outcomes. From this perspective, the current findings highlight the importance of CBT-based interventions in reducing anxiety and improving meta-emotions, which may reduce stress and enhance the quality of life for IBS patients. Studies, such as Zhao, *et al*, emphasize that emotion regulation interventions can mitigate the adverse effects of stress on patients by reducing negative thoughts and improving cognitive function^[21].

This study has several limitations. First, the cross-sectional design limits the ability to assess long-term changes in relationships among variables. Second, given that the data were collected from a specific population in Tabriz, the generalizability of the results may be limited. Finally, more in-depth analysis using precise diagnostic tools, such as clinical interviews and behavioral assessments, could provide a more comprehensive and accurate understanding of the interactions between perceived stress, negative meta-emotions, and cognitive biases.

Overall, the findings indicate that negative meta-emotions can amplify the effects of stress and hostile attribution on cognitive biases in IBS patients, serving as an important mediating variable. This underscores the value of psychological interventions in IBS treatment. Future studies should employ longitudinal designs and larger, more diverse populations to investigate the

role of psychotherapeutic interventions and the reduction of negative meta-emotions in alleviating cognitive and physical symptoms in these patients.

Conclusion

This study highlights the influential role of perceived stress, hostile attribution, and negative meta-emotions in shaping cognitive biases among patients with IBS. Findings demonstrate that perceived stress and hostile attribution are significant contributors to cognitive biases, with negative meta-emotions such as anxiety and depression serving as crucial mediators. These results support a biopsychosocial model of IBS, indicating that symptoms are not purely physical but are also substantially impacted by psychological and emotional factors.

Additionally, the study confirms that individuals with higher levels of hostile attribution are more prone to negative cognitive biases, which can worsen both psychological and physical symptoms. The results reinforce the value of cognitive-behavioral and emotion regulation interventions in mitigating these effects. By helping patients manage negative emotions and reduce cognitive biases, such approaches may significantly improve both mental well-being and physical health outcomes in IBS.

In sum, this research underscores the importance of addressing psychological dimensions in IBS treatment. Integrative approaches that combine physical and psychological care could offer IBS patients enhanced relief from symptoms, leading to improved quality of life and overall well-being.

Ethical approval

This study was approved by the Research Ethics Committees of Urmia University of Medical Sciences - Imam Khomeini University Hospital (ethical code: IR.UMSU.HIMAM.REC.1403.033).

Consent

Written informed consent was obtained from the patient for publication and any accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

Table 4**Bootstrapping results for mediating effects analysis**

Indirect path	Indirect effect	Lower confidence interval (95%)	Upper confidence interval (95%)	Significance level
Perceived Stress → Negative Meta-emotions → Cognitive Bias	0.33	0.25	0.42	0.001
Hostile Attribution → Negative Meta-emotions → Cognitive Bias	0.28	0.19	0.37	0.001

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There were no financial sponsors for this study.

Author contribution

E.S. and M.CH.: study concept, design, data collection, data analysis, interpretation, writing the paper. Both authors accept full responsibility for the study.

Conflicts of interest disclosure

The author declares no conflict of interest.

Research registration unique identifying number (UIN)

This study is a non-interventional, cross-sectional survey, classified as observational research. As such, it does not fall under the category of interventional studies or clinical trials and therefore is not registered with the Iranian Clinical Trial Registration Center (IRCT). The IRCT limits registrations to interventional studies to maintain compatibility with the WHO portal and does not include observational research.

Guarantor

Esmail Soleimani and Mahdi Chitsaz.

Provenance and peer review

Not commissioned, externally peer-reviewed.

Data availability statement

Data are available from authors on request.

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