

Psychological stress and eating behaviors as interacting influences on patient–reported disease activity in Italian patients with inflammatory bowel disease

Authors	Usta, Dilara;Acampora, Marta;Pereira, Andresa Costa;Savarese, Mariarosaria;De Rocchis, Maria Stella;Avedano, Luisa;Leone, Salvo;Graffigna, Guendalina;Segal, Eran
Citation	Usta, D., Acampora, M., Pereira, A.C., Savarese, M., De Rocchis, M.S., Avedano, L., Leone, S., Graffigna, G., Segal, E. (2026). Psychological stress and eating behaviors as interacting influences on patient–reported disease activity in Italian patients with inflammatory bowel disease. <i>Scientific Reports</i> , 16(1), 322-322. https://doi.org/10.1038/s41598-025-29573-3
DOI	10.1038/s41598-025-29573-3
Publisher	Springer Nature
Download date	2026-06-07 04:28:40
Link to Item	https://hdl.handle.net/20.500.14634/1886



OPEN Psychological stress and eating behaviors as interacting influences on patient-reported disease activity in Italian patients with inflammatory bowel disease

Dilara Usta^{1,2}✉, Marta Acampora^{1,3}, Andresa Costa Pereira^{1,2}, Mariarosaria Savarese^{1,3}, Maria Stella De Rocchis⁴, Luisa Avedano⁴, Salvo Leone^{4,5}, Guendalina Graffigna^{1,2} & miGut-Health consortium*

Diet and psychological stress are recognized contributors to inflammatory bowel disease (IBD), yet their interaction—particularly stress-induced eating—remains underexplored. This study examined how perceived stress relates to comfort food consumption (CFC) and patient-reported outcomes among individuals with IBD. A cross-sectional online survey was conducted with 2,254 Italian patients recruited via a national patient organization. Participants completed the Perceived Stress Scale, Salzburg Stress Eating Scale, IBD Symptom Inventory, Bristol Stool Chart, and ad hoc items on CFC. Analyses included partial correlations controlling demographic and clinical covariates, group comparisons by stress level and IBD subtype, and latent class analysis (LCA) to identify psychosocial profiles. Participants reported moderate stress and increased CFC under stress. Those with higher perceived stress described greater symptom burden, softer stool consistency, more frequent CFC, and stronger emotional reliance on these foods. The LCA identified two subgroups—one low-stress/low-symptom and another high-stress/high-symptom/high-comfort-food—highlighting a stress-reactive behavioral phenotype. Stress-eating scores and food preferences did not differ by disease subtype, although patients with Crohn's disease reported higher symptom severity and softer stools. Findings underscore perceived stress as a key psychological correlate of eating behaviors and symptom perception in IBD, supporting the integration of patient-reported experiences into multidisciplinary, engagement-oriented care.

Keywords Comfort food, Inflammatory bowel disease, Patient engagement, Patient-reported outcome measures, Perceived stress, Stress-eating

Inflammatory bowel disease (IBD), encompassing Crohn's disease and ulcerative colitis, is a chronic condition with alternating periods of remission and flare¹, affecting over five million people globally and over 0.2% of the European population². The relapsing inflammation of IBD leads to burdensome gastrointestinal symptoms such as abdominal pain, diarrhea, and rectal bleeding, as well as weight loss, fatigue, and nutrient deficiencies, which profoundly affect health-related quality of life and psychosocial well-being^{3,4}. Symptoms of IBD arise through complex interactions involving environmental triggers, underscoring the multifactorial nature of the disease⁵, and dietary habits play a critical role in modulating gut inflammation and shaping the intestinal microbiome, drawing increasing research attention^{6,7}. Recent evidence underscores that specific dietary patterns, particularly those high in saturated fats, cholesterol, processed foods, and artificial additives, have been implicated in the rising incidence of IBD and symptom exacerbation⁸. Diets high in animal protein, particularly red and processed

¹EngageMinds HUB – Consumer, Food & Health Engagement Research Center, Catholic University of Sacred Heart, Sede di Santa Monica, Via Bissolati, 26100 Cremona, Italy. ²Faculty of Agriculture, Food and Environmental Sciences, Catholic University of Sacred Heart, 26100 Cremona, Italy. ³Department of Psychology, Catholic University of Sacred Heart, 20123 Milan, Italy. ⁴International Federation of Crohn's & Ulcerative Colitis Associations (IFCCA), Brussels, Belgium. ⁵National Association for Chronic Inflammatory Bowel Diseases (A.M.I.C.I. ETS), 20125 Milan, Italy. *A list of authors and their affiliations appears at the end of the paper. ✉email: dilara.cengiz@unicatt.it

meats, have been linked to increased IBD risk and flare-ups⁹. In contrast, anti-inflammatory diets rich in plant-based foods and unsaturated fats are associated with lower disease incidence and severity, positioning dietary change as a promising adjunctive strategy¹⁰.

While biological mechanisms remain central to understanding IBD, contemporary psychosocial and health psychology frameworks emphasize that patients' subjective experiences, how they perceive their symptoms, interpret disease activity, and evaluate their own quality of life, are equally crucial for comprehensive disease assessment¹¹. Within this perspective, patient-reported outcome measures (PROMs) provide indispensable insights into aspects of illness that objective biomarkers cannot fully capture, such as emotional distress, coping strategies, and engagement in self-management. This perspective is conceptually grounded in the broader paradigm of patient engagement, which frames patients as active agents in managing their health rather than passive recipients of care¹². Assessing PROMs thus represents a practical expression of this paradigm, enabling the integration of patients' voices and lived experiences into clinical decision-making and supporting a more holistic model of IBD care¹³.

In parallel, psychological stress has emerged as a significant factor influencing the onset, progression, and lived experience of IBD. Stress contributes to mucosal inflammation through neuroendocrine activation, impaired immune regulation, and increased intestinal permeability¹⁴. Importantly, the relationship is bidirectional: stress not only exacerbates disease activity but is also intensified by the psychological and social burden of chronic illness, establishing a self-perpetuating cycle that amplifies both physical symptoms and emotional distress¹⁵. Empirical evidence indicates that elevated stress levels are associated with increased disease flares and symptom severity¹⁶. However, beyond biological mechanisms, patients' perceptions, psychological states, and self-reported outcomes play a decisive role in shaping engagement with disease management and influencing coping, adherence, and quality of life, even in the absence of measurable inflammatory activity.

One clinically meaningful yet understudied manifestation of this interaction is stress-induced eating behavior, or "stress-eating"^{17,18}. Typically characterized by increased intake of highly palatable, energy-dense foods rich in sugar, fat, or caffeine, stress-eating functions as an emotional strategy to alleviate discomfort in the absence of hunger¹⁹. While these behaviors may offer short-term emotional relief²⁰, they are likely to aggravate gastrointestinal symptoms and impair well-being in individuals with IBD. Neurobiological, hedonic, and affective mechanisms underpin these behaviors^{21,22}, but they are also embedded in the subjective experience of illness, highlighting the importance of addressing emotional and behavioral dimensions of eating within patient-centered IBD care and research grounded in PROMs and patient engagement. Despite their clinical relevance, the influence of stress-related dietary patterns on patient-reported outcomes and disease management remains insufficiently explored.

Although both diet and stress are recognized as contributors to IBD, their interaction remains insufficiently investigated. Existing studies often examine these factors in isolation, overlooking their dynamic interplay and potential compounding effects on disease activity and daily functioning. Moreover, limited attention has been paid to how patients themselves perceive these interconnections and translate them into coping behaviors, an omission that constrains the development of genuinely patient-centered care models. From a patient engagement perspective, understanding how individuals perceive and respond to their own symptoms and emotional states is essential, as these subjective experiences often guide coping behaviors and influence adherence, regardless of objective disease markers. Addressing this gap is crucial for advancing comprehensive, patient-centered approaches that integrate psychological, nutritional, and experiential dimensions of IBD management.

To address this limitation, the present study employs a multidimensional framework to investigate how perceived psychological stress affects comfort food consumption and how these behaviors are related to patient-reported disease activity, stool consistency, and stress-eating tendencies among individuals with IBD. Drawing on a large, well-characterized Italian patient cohort and utilizing validated psychometric instruments, along with pilot-tested dietary assessment items, the study emphasizes patients' own perceptions and self-reported outcomes as key sources of insight into behavioral mechanisms linking stress, eating, and well-being. These dynamics are further examined within the sociocultural context of Italy, where food occupies a central emotional and social role.

Based on these premises, and grounded in empirical observations of associations between psychological distress, disease activity, and maladaptive eating behaviors in IBD, the study proposes the following hypotheses:

- H₁: Higher perceived stress will be positively associated with the frequency of reported stress-related eating behaviors and the importance attributed to comfort foods for emotional regulation.
- H₂: IBD patients with higher perceived stress levels will report significantly higher disease activity and softer stool consistency compared to those with lower perceived stress.
- H₃: IBD patients with higher perceived stress will report significantly higher rates of increased consumption of comfort foods, compared to those with lower perceived stress.

Methods

Study design

This study adopted a cross-sectional design. Data were collected from IBD patients via an online survey utilizing validated questionnaires and study-specific ad-hoc items to capture context-specific eating behaviors not covered by existing instruments. The study was conducted within the framework of the miGut-Health Project (Horizon Europe, Grant Agreement No. 101095470), specifically under Work Package 5, which focuses on the assessment and clustering of citizens' health engagement risk profiles through the identification of behavioral, psychological, and psychosocial factors that influence engagement in gut health promotion and disease prevention. The current study adhered to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines for cross-sectional studies, ensuring transparent and comprehensive reporting.

Participants and data collection procedure

Participants were recruited through purposive sampling via the Italian IBD patient organization, “Associazione Nazionale per le Malattie Infiammatorie Croniche dell’Intestino” (A.M.I.C.I. ETS), which distributed a survey link to its registered members between May 17 and August 9, 2024, thereby enabling access to a well-defined patient population. Eligibility criteria included: (i) age ≥ 18 years, (ii) sufficient proficiency to understand and complete the questionnaire, and (iii) provision of informed consent. Individuals who were unable to complete the online survey independently or lacked internet access were excluded.

The required sample size ($N = 1870$) was estimated using G*Power 3.1.9.7 software, with an anticipated small-to-moderate effect size (0.15), power ($1 - \beta$) of 0.90, and alpha (α) level of 0.05, consistent with Cohen’s recommendations²³, and previous literature highlighting meaningful yet modest associations among study variables²⁴. Of the 2,666 individuals who accessed the survey, 412 were excluded for not completing informed consent procedures, resulting in a final analytic sample of 2,254 participants, corresponding to an 84.5% completion rate among those who accessed the survey link. To ensure data integrity, all responses underwent rigorous screening prior to analysis. Incomplete surveys were automatically excluded, and the median completion time for the final analytic sample was 25 minutes. The dataset was further examined for duplicate IP addresses, of which none were identified, and for response patterns showing multiple consecutive identical answers, which were also not detected, to confirm the reliability of the final dataset.

Potential participants received an email outlining the study’s aims and procedures, including a secure link to an online survey hosted on Qualtrics (Qualtrics XM, Utah, USA). Upon accessing the platform, participants reviewed an electronic informed consent form detailing study objectives, confidentiality assurances, potential risks and benefits, and the voluntary nature of participation. Consent was provided electronically by selecting an “Accept” button; individuals who declined consent were automatically redirected and thanked without further participation.

Instruments

The study was based on a self-administered online questionnaire of validated psychometric scales and ad hoc items. The questionnaire included a demographic and disease-related information form, the Inflammatory Bowel Disease Symptom Inventory—Short Form, the Bristol Stool Chart, the 10-item Perceived Stress Scale, the Salzburg Stress Eating Scale, and ad hoc items regarding comfort food consumption. Survey instruments were translated into Italian following standard cross-cultural adaptation procedures, which included forward and backward translation by bilingual experts, reconciliation by the research team, and pre-testing for semantic and conceptual equivalence²⁵.

Demographics and disease-related characteristics

Sociodemographic and disease-related data included age, sex, level of education, current employment status, and household composition. Disease-related variables included IBD type and duration, presence of comorbidities, surgical history, regular medication use, previous psychological consultations, and engagement with psychological services.

Inflammatory bowel disease symptom inventory – short form

Disease activity over the past seven days was assessed using the short form of the Inflammatory Bowel Disease Symptom Inventory (IBDSI-SF), a validated 24-item instrument derived from the original 35-item IBDSI²⁶. The IBDSI-SF is a patient-reported, clinically validated tool that reliably detects IBD disease activity with high sensitivity and specificity²⁶. Items on the IBDSI-SF have variable response options based on symptom characteristics; most items are scored on a scale ranging from 0 (“none”) to 4 (“severe”), ensuring equal weighting. Two exceptions are items assessing fistula activity (scored 0–5) and blood in stool (scored 0–2). Total IBDSI-SF scores range from 0 to 95, with higher scores indicating greater disease severity. Validated cutoff scores defining active disease are greater than 14 for Crohn’s disease and greater than 13 for ulcerative colitis. The IBDSI-SF demonstrated good internal consistency (Cronbach’s $\alpha = 0.881$) in this study.

Bristol stool chart

Participants were asked to report their average stool consistency over the past seven days using the Bristol Stool Chart (BSC), an ordinal scale developed by Lewis and Heaton (1997) based on observations from 66 volunteers²⁷. The scale classifies stool types from Type 1 (hardest) to Type 7 (softest), with Types 1–2 indicating constipation and Types 6–7 suggesting diarrhea. Stool Types 3–5 are typically regarded as “normal” and are commonly reported among healthy adults. The BSC incorporates both descriptive and pictorial representations to improve accuracy and usability²⁸.

10-item perceived stress scale

The Perceived Stress Scale (PSS), originally developed by Cohen et al. (1983), is a widely used self-report measure that assesses the degree to which situations in one’s life are perceived as stressful²⁹. The short form (PSS-10), validated in Italian by Mondo et al. (2021), consists of 10 items—six negatively phrased and four positively phrased—each rated on a 5-point Likert scale from 0 “never” to 4 “very often”³⁰. Items inquire about stress-related experiences within a specified time frame; although originally focused on the previous four weeks, the present study adapted the time frame to the past seven days to align with other measures. While this modification ensured temporal consistency across instruments, it may affect direct comparability with studies using the standard 4-week timeframe. After reverse-scoring positively worded items, total scores are summed, ranging from 0 to 40, with higher scores indicating greater perceived stress. In this study, participants were

classified into two groups based on perceived stress levels using a validated cut-off score (PSS-10: <21 “low,” ≥21 “high”)³⁰. The present study yielded high internal consistency (Cronbach’s $\alpha = 0.901$).

Salzburg stress eating scale

Stress-related eating behavior was assessed using the Salzburg Stress Eating Scale (SSES), a validated 10-item self-report questionnaire that evaluates changes in food intake in response to stress¹⁸. Items (e.g., “When I am overwhelmed with things I have to do...”, “When I am under pressure...”) are rated on a 5-point scale from 1 (“I eat much less than usual”) to 5 (“I eat much more than usual”). Higher mean scores reflect increased eating in response to stress, whereas lower mean scores indicate reduced intake; mean scores around 3 indicate no significant stress-induced changes in eating behavior. The scale demonstrates high internal reliability, strong factorial validity with a unidimensional structure invariant across genders, and convergent validity with emotional eating measures. Its lack of direct association with perceived stress supports its discriminant validity, confirming that stress-induced eating and perceived stress represent related but distinct constructs¹⁸. The current study demonstrated high internal consistency, with a Cronbach’s α of 0.941.

Comfort food consumption

Comfort food consumption patterns were assessed using a set of ad hoc items developed specifically for this study, informed by expert consensus among consortium partners and supported by existing literature on dietary behaviors in IBD populations⁶. The content validity of the ad hoc items was assessed through a structured review process involving three experts in health psychology, clinical nutrition, and gastroenterology, who independently evaluated the relevance, clarity, and theoretical coherence of the items in relation to the study constructs. Minor modifications were made based on inter-rater feedback prior to pilot testing with 15 IBD patients. Participants reported the frequency of their intake of seven food and beverage categories (alcoholic beverages, chocolate, coffee, fast food, savory snacks, sweet snacks, and sweetened beverages) over the preceding seven days, with response options ranging from 0 “never” to 5 “2 or more times per day.” The 7-day timeframe was selected across measures to enhance temporal alignment and reduce recall bias across constructs. They also indicated whether their consumption of these items had increased compared to their usual intake during the past week, specifying affected categories. Additionally, participants were asked whether they typically consumed greater amounts of these foods during periods of heightened stress and rated the importance of consuming specific foods or beverages as a stress-management strategy on a five-point scale from 1 “not important at all” to 5 “very important.” Internal consistency of the seven-item comfort food frequency scale was acceptable, with a Cronbach’s α of 0.767.

Statistical analysis

Statistical analyses were conducted using IBM® SPSS 29 (IBM Corp., Armonk, USA) and R version 4.5.1. Descriptive statistics of the sample were computed to assess the composition of the sample. Scales were scored according to the literature^{18,26–28}. For the descriptive data, the categorical variables were represented as frequencies (percentages), and the continuous variables were provided as means (standard deviations). The normality of the continuous variables (patient-reported disease activity scores, stool consistency, perceived stress scores, stress-eating scores, and perceived importance of comfort foods) was assessed using the Shapiro-Wilk test, yielding p -values > 0.05, indicating no significant deviation from normality. Given the large sample size ($N = 2254$) and recognizing that parametric tests are robust to minor deviations from normality in large samples³¹, parametric tests were deemed appropriate for subsequent analyses.

Partial correlation analysis was conducted to examine relationships among patient-reported disease activity, stool consistency, perceived stress, reported stress-eating behaviors, and comfort food consumption, controlling for age, sex, duration of IBD diagnosis, IBD subtype, and presence of comorbidities. Covariates included in the partial correlation analysis were selected based on prior literature indicating their potential influence on disease activity, psychological distress, and dietary behaviors in IBD populations^{32–35}. The correlation strength (r) was interpreted as strong ($r \geq 0.7$), moderate ($0.3 \leq r < 0.7$), or weak ($r < 0.3$)³⁶. Group differences in categorical variables, including increased consumption of comfort food compared to usual in the past seven days, consumption of comfort food under stress (self-reported habitual behavior under stress), and consumed food groups, were assessed using chi-square tests. Pairwise comparisons were performed using Z-score tests and Bonferroni corrections. Differences between continuous variables, namely the perceived importance of comfort foods when stressed, patient-reported disease activity, stool consistency, and stress-eating scores, were examined through independent samples t-tests. For analyses comparing differences by IBD type, only participants diagnosed with Crohn’s disease or ulcerative colitis were included. Cases classified as indeterminate colitis or with unspecified IBD type ($n = 31$) were excluded due to their small number and insufficient statistical power for meaningful subgroup analysis. There was no missing data in the dataset; therefore, no imputation or data handling procedures were required. Finally, a Latent Class Analysis (LCA) was performed to identify unobserved subgroups of patients based on three categorical indicators: perceived stress, patient-reported disease activity, and increased consumption of comfort foods during the past seven days. The analysis was conducted using the *poLCA* package (version 1.6.0.1) in R. Models specifying two to five latent classes were estimated via maximum likelihood with 10 random sets of starting values to ensure convergence to a global optimum. The optimal number of classes was determined using information criteria, specifically the Bayesian Information Criterion (BIC) and Akaike Information Criterion (AIC), with lower values indicating better model fit. Model stability was verified through 50 replications of the best-fitting model. Classification quality was evaluated by calculating entropy and the misclassification rate. Posterior probabilities were used to assign individuals to their most likely latent class, and conditional item-response probabilities were interpreted to characterize each class. A p -value < 0.05 was considered statistically significant.

Ethical considerations

The study was granted ethical approval by the Ethics Committee of the Department of Psychology, Università Cattolica del Sacro Cuore, Italy (protocol code: 72-24, date: April 22, 2024), and adhered to the principles outlined in the Declaration of Helsinki. Permission to use validated survey instruments was obtained directly from copyright holders via email correspondence. Study procedures were explained digitally, and participants were explicitly informed of their right to withdraw without consequences. On the initial page of the online survey, participants were required to provide informed consent, which was necessary to access the main survey. Participation was voluntary, anonymous, and uncompensated, and all participants provided informed consent.

Results

Demographics and disease-related characteristics

The IBD patient cohort ($N = 2254$) had a mean age of 49.1 years ($SD = 14.22$) and an average disease duration of 17.2 years ($SD = 12.16$). The sample was predominantly female (59.4%, $n = 1339$). Educational attainment was high, with 46.9% ($n = 1056$) having completed high school and 42.0% ($n = 947$) holding a university degree or higher. Most participants were employed (71.6%, $n = 1614$) and either married or cohabited (70.7%, $n = 1593$). Ulcerative colitis was slightly more prevalent (53.5%, $n = 1207$) than Crohn's disease (45.1%, $n = 1016$). Comorbid conditions were reported in 37.0% ($n = 834$) of cases, and 35.6% ($n = 802$) had undergone surgery. A substantial majority (92.2%, $n = 2079$) were receiving regular pharmacological treatment. Regarding psychological aspects, 44.5% ($n = 1004$) had previously consulted a psychologist or psychotherapist, and 14.7% ($n = 332$) were currently receiving psychological support.

Patient-reported disease activity, perceived stress, and stress-eating scores

The mean patient-reported disease activity score, was 20.8 ($SD = 14.31$), indicating moderate disease activity. Self-reported stool consistency averaged 4.5 ($SD = 1.51$), suggesting a mild tendency toward diarrhea-like stool consistency. The PSS-10 yielded a mean score of 17.3 ($SD = 7.74$), reflecting moderate perceived stress levels. Mean stress-related eating scores were 2.8 ($SD = 0.87$) on the SSES, indicating a slight tendency to eat less rather than more in response to stress.

Consumption of comfort food/beverage groups

Table 1 summarizes participants' self-reported consumption patterns of various comfort foods and beverages over the preceding seven days. Coffee was the most frequently consumed item, followed by sweet snacks. Overall, 9.4% ($n = 211$) of participants reported increased consumption of these items during the last seven days. Among those who reported an increased intake, sweet snacks, coffee, and chocolate were the most frequently cited. When under stress, 35.5% reported consuming these food/beverage groups in greater quantity or frequency, with chocolate, sweet snacks, and savory snacks being the most preferred. The mean perceived importance of food and beverages for coping with stress was 2.5 ($SD = 1.15$), with 37.4% considering it "neutral" and 18.8% rating it as "important" or "very important."

Correlations among patient-reported disease activity, perceived stress, stress-eating, and comfort food consumption

Table 2 presents the partial correlation analysis, controlling for age, sex, duration of IBD diagnosis, IBD subtype, and comorbidity status, among the variables: patient-reported disease activity, perceived stress, stress-eating, and comfort food consumption in cases of experiencing psychological stress. Disease activity was positively and moderately associated with stool consistency ($r = 0.442$, $p < 0.001$) and perceived stress ($r = 0.485$, $p < 0.001$), and showed only weak or non-significant links to comfort-food variables ($r = 0.022$ – 0.076 , $p < 0.05$). Perceived stress correlated weakly with stool consistency ($r = 0.192$, $p < 0.001$), with increased comfort-food intake over the past week ($r = 0.111$, $p < 0.001$). Stress-eating exhibited a moderate positive correlation with comfort-food consumption under stress ($r = 0.403$, $p < 0.001$), as well as weaker, yet still significant correlations with increased consumption ($r = 0.230$, $p < 0.001$) and the perceived importance of comfort foods when stressed ($r = 0.173$, $p < 0.001$). Finally, although disease activity correlated significantly with comfort-food-related variables, these associations were weak (Table 2).

Latent class analysis of perceived stress, patient-reported disease activity, and comfort-food consumption

The latent class analysis identified two distinct patient subgroups as the optimal solution, based on the lowest BIC value (BIC = 6961.65; AIC = 6921.61). The model yielded a stable log-likelihood of -3453.80 across all random starts and replications, confirming a global maximum. Classification quality indices indicated an acceptable level of class separation (entropy = 0.72; misclassification rate = 0.16).

The latent classes reflected distinct psychological and behavioral patterns (Table 3). Class 1 comprised 55.6% of participants and was characterized by low perceived stress, low-to-moderate disease activity, and minimal comfort food consumption in the past seven days. This group represents a "low stress/low disease activity/low emotional eating" profile. Class 2, including 44.4% of participants, exhibited higher perceived stress, greater disease activity, and a higher probability of comfort food consumption. This profile reflects a "high stress/high disease activity/higher emotional eating" pattern, suggesting a psychosocial vulnerability cluster in which stress may contribute to maladaptive eating and higher disease burden.

Items	Mean ± SD/n (%)
How often did you consume the following food/beverage groups in the past seven days?	
Alcoholic beverages	1.01 ± 1.27
Chocolate	1.16 ± 1.28
Coffee	3.15 ± 1.95
Fast food	0.31 ± 0.57
Savory snacks	1.22 ± 1.17
Sweet snacks	1.95 ± 1.57
Sweetened beverages	0.62 ± 1.08
Have you consumed more than usual amounts of the following food groups in the past seven days?	
No	2043 (90.6)
Yes	211 (9.4)
Comfort foods consumed more than usual amounts in the past seven days* (n = 476)	
Alcoholic beverages	71 (14.9)
Chocolate	75 (15.7)
Coffee	80 (16.8)
Fast-food	29 (6.1)
Savory snacks	65 (13.7)
Sweet snacks	94 (19.8)
Sweetened beverages	62 (13.0)
Do you consume these foods more than usual when you feel stressed?	
No	1456 (64.6)
Yes	798 (35.4)
Comfort foods consumed more than usual amounts when feeling stressed* (n = 1825)	
Alcoholic beverages	154 (8.5)
Chocolate	425 (23.2)
Coffee	220 (12.1)
Fast-food	118 (6.5)
Savory snacks	385 (21.0)
Sweet snacks	400 (22.0)
Sweetened beverages	123 (6.7)
How important is it for you that a food/beverage helps you manage your stress?	
Not important at all	580 (25.7)
Somewhat important	407 (18.1)
Neutral	842 (37.4)
Important	314 (13.9)
Very important	111 (4.9)

Table 1. Comfort food consumption of IBD patients (n = 2254). *Multiple answers.

Variables	Patient-reported disease activity	Stool consistency	Perceived stress	Stress-eating	Increased consumption of comfort food compared to usual in the past seven days	Comfort food consumption when feeling stressed	Importance of comfort food when feeling stressed
Patient-reported disease activity (IBDSI-SF)	-						
Stool consistency (BSC)	0.442**	-					
Perceived stress (PSS-10)	0.485**	0.192**	-				
Stress-eating (SSES)	-0.122**	-0.066*	0.012	-			
Increased consumption of comfort food compared to usual in the past seven days	0.067**	0.011	0.111**	0.230**	-		
Comfort food consumption when feeling stressed	0.022	-0.012	0.184**	0.403**	0.202**	-	
Importance of comfort food when feeling stressed	0.076**	-0.051*	0.118**	0.173**	0.102**	0.195**	-

Table 2. Partial correlations between study variables (n = 2254). IBDSI-SF, Inflammatory Bowel Disease Symptom Inventory Short Form; BSC, Bristol Stool Chart; PSS-10, Perceived Stress Scale; SSES, Salzberg Stress Eating Scale. *Statistically significant at the p < 0.05 level. **Statistically significant at the p < 0.001 level.

Variable	Class 1 – Low stress/Low disease activity/Low comfort food consumption (n = 1,258; 55.6%)	Class 2 – High stress/High disease activity/Higher comfort food consumption (n = 996; 44.4%)
Perceived stress (<i>PSS-10</i>)	95.8% “Low” 4.2% “High”	31.9% “Low” 68.0% “High”
Patient-reported disease activity (<i>IBDSI-SF</i>)	55.3% “Low” 44.7% “High”	10.7% “Low” 89.3% “High”
Comfort food consumption	94.6% “Low” 5.4% “High”	85.7% “Low” 14.3% “High”
Fit indices (2-class solution)	AIC = 6921.61 BIC = 6961.65 Log-likelihood = -3453.80	
Classification quality	Entropy = 0.72 Misclassification rate = 0.16	

Table 3. Latent class analysis results for perceived stress, patient-reported disease activity, and comfort food consumption in the past seven days (n = 2254). *PSS-10*, Perceived Stress Scale; *IBDSI-SF*, Inflammatory Bowel Disease Symptom Inventory Short Form.

Differences in receiving psychological support, stress-induced eating behaviors, and patient-reported disease activity by IBD type

Table 4 compares psychological and behavioral characteristics between individuals with Crohn’s disease and those with ulcerative colitis. Participants with Crohn’s disease were slightly overrepresented among those who had previously consulted a psychologist ($\chi^2 = 11.750$, $p < 0.001$). No significant differences emerged in current psychotherapy use or stress-related eating behaviors, including comfort food consumption, between participants with Crohn’s disease and those with ulcerative colitis ($p > 0.05$). Across specific food categories (e.g., chocolate, fast food, sweet snacks), consumption patterns when stressed did not significantly differ by IBD type. Similarly, perceived stress levels, the importance of comfort food under stress, and stress-eating tendencies did not differ significantly by the type of IBD ($p > 0.05$). However, participants with Crohn’s disease reported significantly higher disease activity ($t = 4.198$, $p < 0.001$) and softer stool consistency ($t = 8.140$, $p < 0.001$).

Differences in receiving psychological support, stress-induced eating behaviors, and patient-reported disease activity by perceived stress level

Table 5 summarizes the differences in self-reported comfort food consumption, stool consistency, disease activity, and eating behaviors according to participants’ perceived stress levels. Participants with high perceived stress levels more frequently reported previous psychological consultations ($\chi^2 = 81.980$) and were more likely to be currently engaged in psychotherapy or psychological support ($\chi^2 = 97.882$). A significantly greater proportion of highly stressed participants reported increased comfort food consumption during stress compared to those with low stress ($\chi^2 = 84.022$, $p < 0.001$). Highly stressed participants were more likely to consume chocolate ($\chi^2 = 55.468$), fast food ($\chi^2 = 14.139$), coffee ($\chi^2 = 27.251$), sweetened beverages ($\chi^2 = 14.147$), alcoholic beverages ($\chi^2 = 10.198$), savory snacks ($\chi^2 = 46.050$), and sweet snacks ($\chi^2 = 44.874$) under stress (all $p < 0.001$). They also rated comfort foods as significantly more important in coping with stress ($t = -4.004$; $p < 0.001$). Additionally, participants with high stress reported higher disease activity ($t = -21.149$, $p < 0.001$) and softer stool consistency ($t = 17.845$, $p < 0.001$) compared to those with low stress. However, no significant difference was found in stress-eating scores between the two groups ($t = -1.347$, $p = 0.178$).

Discussion

The present research offers novel and clinically meaningful insights into the complex interplay between psychological stress, dietary behaviors, and patient-reported outcomes in individuals with IBD. By focusing on perceived stress and self-reported symptoms, our study contributes to the growing literature that recognizes the value of PROMs in capturing the lived experience of chronic illness. This approach highlights that understanding how patients perceive and cope with stress provides an essential complement to biological indicators of disease activity, offering a more comprehensive view of how psychological and behavioral factors shape everyday well-being. Consistent with Hypothesis 1, individuals reporting higher levels of perceived stress also tended to report greater reliance on energy-dense comfort foods and more severe subjective symptom burden, suggesting that emotional distress may be intertwined with maladaptive eating patterns and perceived disease worsening. Rather than implying physiological causation, these associations highlight the experiential dimension of IBD, emphasizing the importance of integrating subjective perspectives into both clinical care and research.

In line with Hypothesis 2, the observed association between elevated perceived stress, worsened self-reported disease activity, and softer stool consistency reflects patients’ subjective appraisal of how stress influences their symptoms. This perception is consistent with biopsychological models, which propose that stress may interact with gut physiology through mechanisms such as hypothalamic–pituitary–adrenal axis dysregulation, increased intestinal permeability, and microbial imbalance³⁷. Previous studies have documented that chronic stress can precipitate or intensify symptom experiences in IBD and impair recovery processes^{38,39}. Our findings extend this understanding by showing that stress may also act as a behavioral catalyst, shaping coping responses, particularly the increased consumption of high-sugar, high-fat, and ultra-processed comfort foods. While evidence from general gut health research suggests that such foods can negatively affect intestinal barrier function, inflammatory

Variables [†]	IBD type		Test value ^{a,b}	p-value
	Crohn's disease (n = 1016)	Ulcerative colitis (n = 1207)		
	Mean ± SD/n (%)	Mean ± SD/n (%)		
Previous psychological consultations ^a				
Yes (n = 992)	494 (48.6)	498 (41.4)	$\chi^2 = 11.750$	<0.001 [*]
Current engagement in psychotherapy or psychological support ^a				
Yes (n = 328)	149 (14.7)	179 (14.8)	$\chi^2 = 0.014$	0.907
Increased consumption of comfort food compared to usual in the past seven days ^a				
Yes (n = 209)	97 (9.5)	112 (9.3)	$\chi^2 = 0.047$	0.829
Consumed food/beverage groups ^a				
Alcoholic beverages (n = 71)	30 (3.0)	41 (3.4)	$\chi^2 = 0.352$	0.553
Chocolate (n = 75)	32 (3.1)	43 (3.6)	$\chi^2 = 0.289$	0.591
Coffee (n = 79)	33 (3.2)	46 (3.8)	$\chi^2 = 0.510$	0.475
Fast food (n = 29)	15 (1.5)	14 (1.2)	$\chi^2 = 0.429$	0.512
Savory snacks (n = 65)	33 (3.2)	32 (2.7)	$\chi^2 = 0.692$	0.405
Sweet snacks (n = 93)	45 (4.4)	48 (4.0)	$\chi^2 = 0.282$	0.596
Sweetened beverages (n = 62)	30 (3.0)	32 (2.7)	$\chi^2 = 0.185$	0.667
Comfort food consumption when stressed (self-reported habitual behavior under stress) ^a				
Yes (n = 790)	367 (36.1)	423 (35.0)	$\chi^2 = 0.279$	0.597
Consumed food/beverage groups ^a				
Alcoholic beverages (n = 153)	75 (7.4)	78 (6.5)	$\chi^2 = 0.728$	0.394
Chocolate (n = 422)	188 (18.5)	234 (19.4)	$\chi^2 = 0.280$	0.597
Coffee (n = 215)	107 (10.5)	108 (8.9)	$\chi^2 = 1.584$	0.208
Fast food (n = 117)	59 (5.8)	58 (4.8)	$\chi^2 = 1.110$	0.292
Savory snacks (n = 383)	187 (18.4)	196 (16.2)	$\chi^2 = 1.816$	0.178
Sweet snacks (n = 396)	173 (17.0)	223 (18.5)	$\chi^2 = 0.790$	0.374
Sweetened beverages (n = 123)	65 (6.4)	58 (4.8)	$\chi^2 = 2.676$	0.102
Importance of comfort food when feeling stressed ^b	2.50 ± 1.15	2.58 ± 1.14	t = -1.708	0.088
Perceived stress ^b (PSS-10)	17.22 ± 7.66	17.32 ± 7.84	t = -0.306	0.759
Patient-reported disease activity ^b (IBDSI-SF)	22.17 ± 14.12	19.61 ± 14.44	t = 4.198	<0.001 [*]
Stool consistency ^b (BSC)	4.75 ± 1.55	4.23 ± 1.44	t = 8.140	<0.001 [*]
Stress-eating ^b (SSES)	2.78 ± 0.86	2.82 ± 0.88	t = -1.186	0.236

Table 4. Comparison of psychological support, stress-related eating behaviors, and clinical characteristics between Crohn's disease and ulcerative colitis patients (n = 2223). [†]Column totals are reported. ^aChi-square test, ^bIndependent samples t-test, ^{*}Statistically significant. SD, Standard deviation, IBDSI-SF, Inflammatory Bowel Disease Symptom Inventory Short Form; BSC, Bristol Stool Chart; PSS-10, Perceived Stress Scale; SSES, Salzburg Stress Eating Scale.

cytokines, and microbial diversity⁴⁰, the present results situate these mechanisms within patients' perceived experiences rather than objective pathology. Notably, the cross-sectional design precludes causal inference: heightened stress and stress-related eating may both arise as consequences of perceived symptom burden and as coping expressions of psychological distress, thereby reinforcing a self-perpetuating cycle between emotion, behavior, and symptom perception.

Consistent with these individual-level associations, the latent class analysis provided a complementary, person-centered perspective on how stress-related psychological and behavioral processes coalesce within the IBD population. Two distinct psychosocial profiles emerged: one marked by low perceived stress, lower disease activity, and minimal comfort-food consumption, and another characterized by higher stress, more active disease, and increased use of comfort food as a coping strategy. The latter profile, encompassing nearly half of participants, mirrors prior evidence suggesting that stress-related emotional dysregulation and maladaptive eating frequently co-occur in IBD and other chronic illnesses^{41,42}. Similar stress-reactive subgroups have been reported, where heightened emotional distress is linked to unhealthy dietary patterns and symptom exacerbation⁴³. These findings reinforce biopsychological models proposing that stress serves as both a physiological activator and a behavioral organizer, influencing symptom perception, food choice, and adherence to dietary recommendations. The identification of a stress-reactive behavioral phenotype within the IBD population provides a useful framework for developing tailored interventions that integrate psychological and nutritional care, particularly for patients whose stress coping is mediated through eating behaviors.

The two-class solution demonstrated good overall classification quality (entropy = 0.72), indicating clear yet not absolute differentiation between subgroups. Comparable entropy levels have been reported in other psychosocial LCA studies of chronic disease populations, where the interplay of emotion, cognition, and

Variables [†]	Perceived stress (PSS-10)		Test value ^{a,b}	p-value
	Low (n = 1521)	High (n = 733)		
	Mean ± SD/n (%)	Mean ± SD/n (%)		
Previous psychological consultations ^a				
Yes (n = 1004)	577 (38.0)	427 (58.3)	$\chi^2 = 81.980$	<0.001 [*]
Current engagement in psychotherapy or psychological support ^a				
Yes (n = 332)	146 (9.6)	186 (25.4)	$\chi^2 = 97.882$	<0.001 [*]
Increased consumption of comfort food compared to usual in the past seven days ^a				
Yes (n = 211)	111 (7.3)	100 (13.6)	$\chi^2 = 23.467$	<0.001 [*]
Consumed food/beverage groups ^a				
Alcoholic beverages (n = 71)	36 (2.4)	35 (4.8)	$\chi^2 = 9.402$	0.002 [*]
Chocolate (n = 75)	37 (2.4)	38 (5.2)	$\chi^2 = 11.642$	<0.001 [*]
Coffee (n = 80)	41 (2.7)	39 (5.3)	$\chi^2 = 9.956$	0.002 [*]
Fast food (n = 29)	14 (0.9)	15 (2.0)	$\chi^2 = 4.937$	0.026 [*]
Savory snacks (n = 65)	31 (2.0)	34 (4.6)	$\chi^2 = 11.942$	<0.001 [*]
Sweet snacks (n = 94)	45 (3.0)	49 (6.7)	$\chi^2 = 17.185$	<0.001 [*]
Sweetened beverages (n = 62)	30 (2.0)	32 (4.4)	$\chi^2 = 10.591$	<0.001 [*]
Comfort food consumption when stressed (self-reported habitual behavior under stress) ^a				
Yes (n = 798)	441 (29.0)	357 (48.7)	$\chi^2 = 84.022$	<0.001 [*]
Consumed food/beverage groups ^a				
Alcoholic beverages (n = 154)	86 (5.7)	68 (9.3)	$\chi^2 = 10.198$	<0.001 [*]
Chocolate (n = 425)	222 (14.6)	203 (27.7)	$\chi^2 = 55.468$	<0.001 [*]
Coffee (n = 220)	114 (7.5)	106 (14.5)	$\chi^2 = 27.251$	<0.001 [*]
Fast food (n = 118)	61 (4.0)	57 (7.8)	$\chi^2 = 14.139$	<0.001 [*]
Savory snacks (n = 385)	203 (13.3)	182 (24.8)	$\chi^2 = 46.050$	<0.001 [*]
Sweet snacks (n = 400)	213 (14.0)	187 (25.5)	$\chi^2 = 44.874$	<0.001 [*]
Sweetened beverages (n = 123)	64 (4.2)	59 (8.0)	$\chi^2 = 14.147$	<0.001 [*]
Importance of comfort food when feeling stressed ^b	2.47 ± 1.14	2.68 ± 1.17	t = -4.004	<0.001 [*]
Patient-reported disease activity ^b (IBDSI-SF)	16.77 ± 11.66	29.21 ± 15.60	t = -21.149	<0.001 [*]
Stool consistency ^b (BSC)	4.31 ± 1.45	4.80 ± 1.59	t = -17.845	<0.001 [*]
Stress-eating ^b (SSES)	2.78 ± 0.75	2.83 ± 1.07	t = -1.347	0.178

Table 5. IBD patients grouped by high and low levels of perceived stress (n = 2254). [†]Column totals are reported. ^aChi-square test, ^bIndependent samples t-test, ^{*}Statistically significant. SD, Standard deviation, IBDSI-SF, Inflammatory Bowel Disease Symptom Inventory Short Form; BSC, Bristol Stool Chart; PSS-10, Perceived Stress Scale; SSES, Salzburg Stress Eating Scale.

behavior often produces partially overlapping latent profiles^{44,45}. This moderate class overlap aligns with theoretical models of stress and coping⁴⁶, which conceptualize stress responses as fluid processes rather than fixed traits. From this perspective, entropy reflects the natural variability of psychological adaptation in chronic illness: individuals may shift between adaptive and maladaptive states depending on symptom severity, fatigue, and environmental stressors. Thus, rather than indicating measurement imprecision, the entropy value observed here underscores the ecological validity of the identified profiles, capturing the dynamic continuum of stress-related behavior within everyday disease management. Longitudinal studies using latent transition analysis could further clarify how patients move between these profiles over time, offering valuable insight into the temporal plasticity of stress-related eating and disease perception.

Notably, while Crohn's disease patients reported significantly higher disease activity and softer stool consistency compared to those with ulcerative colitis, stress levels, stress-eating tendencies, and comfort food consumption did not differ across disease subtypes. This finding supports the view that emotional and behavioral dysregulation under stress constitutes a transdiagnostic vulnerability across the IBD spectrum⁴⁷, and suggests that the psychological sequelae of chronic inflammation, such as emotional distress, loss of control, and maladaptive coping, may manifest similarly regardless of anatomical disease localization or clinical phenotype³. This convergence aligns with evidence from research indicating shared burdens of psychopathological comorbidity, mood disorders, impaired quality of life, and altered stress processing among all IBD patients⁴⁸. However, these findings contrast with meta-analytic evidence suggesting that patients with Crohn's disease exhibit slightly higher odds of anxiety and depression symptoms compared to those with ulcerative colitis⁴⁹. One possible explanation for this discrepancy is that while trait-level affective symptoms may differ slightly by disease subtype, acute stress-induced behavioral responses (e.g., stress-eating, comfort food use) may be more uniformly distributed across patients due to shared experiences of unpredictability, symptom burden, and

stigma. Taken together, these findings underscore the importance of addressing stress-related emotional and behavioral processes as core therapeutic targets in IBD care, irrespective of disease subtype.

One of the most compelling findings of this study is the mismatch between behavioral indicators and self-reported measures of stress-eating. Although individuals with high perceived stress reported greater consumption of comfort foods and rated them as more important for emotional coping, in line with Hypothesis 3, their mean stress-eating scores did not differ significantly from those of less-stressed participants. This discrepancy may reflect the limitations of self-report tools in capturing the episodic and context-sensitive nature of stress-related eating, particularly in IBD, which may function more as a state-driven response to disease flares, fatigue, or emotional exhaustion than as a stable trait¹⁶. Another plausible explanation may involve the impaired emotional awareness, which is common in both healthy and chronic disease populations and might limit accurate self-assessment of affect-driven behaviors⁵⁰. Individuals may underreport or misinterpret their own stress-eating tendencies due to difficulties in recognizing or attributing emotions to eating behaviors, especially when such behaviors are normalized or culturally sanctioned⁵¹. This pattern may also reflect measurement ceiling or floor effects in the SSES, particularly in a sample where emotional eating is widespread and socially accepted. In such contexts, group differences may be obscured by uniformly elevated baseline responses, masking subtle variability better captured through context-sensitive tools, such as ecological momentary assessment¹⁹. Moreover, self-report instruments often assess stress-eating as a monolithic construct, without distinguishing between food quantity, type, context, or timing; factors that can influence gut responses and symptom exacerbation in IBD⁵².

The distinctiveness of the Italian sociocultural context adds an important interpretative dimension to our findings. Participants reporting high levels of stress also emphasized the heightened importance of comfort food during such periods, an association that may reflect Italy's deeply rooted cultural relationship with food. In the Italian context, eating practices extend beyond nutrition to encompass symbolic, affective, and relational meanings; food serves as a primary medium for expressing care, belonging, and emotional expression⁵³. Shared meals and ritualized food traditions foster social cohesion and emotional exchange⁵⁴, linking food consumption with affect regulation at both interpersonal and individual levels. Previous ethnographic and psychological studies have shown that Italians often associate specific foods with emotional comfort and familial warmth, suggesting that eating under stress may activate these culturally reinforced affective associations rather than representing a purely individual coping response^{55,56}. This perspective situates comfort eating within a broader cultural model of emotional expression, rather than treating it solely as maladaptive behavior. Hence, the Italian context may provide a valuable setting for understanding how cultural meanings of food intersect with psychological processes in chronic disease management.

The implications of these findings are particularly relevant for behavioral interventions, clinical nutrition, and multidisciplinary IBD management. According to the recent ECCO Consensus on Dietary Management of IBD⁵⁷, current evidence remains insufficient to recommend specific anti-inflammatory or exclusionary diets for inducing or maintaining remission in IBD. Nevertheless, many patients attempt to modify their diet in hopes of symptom control, and adherence to restrictive dietary patterns may be further complicated by psychological stress. This underscores the importance of integrating psychologists and behavioral scientists into IBD care to address the emotional, cognitive, and motivational factors that influence eating behaviors. Psychological support in IBD care should extend beyond mood management to encompass the behavioral and emotional dimensions of food-related coping, which are often underrecognized in standard practice.

The observed association between perceived stress and comfort food consumption warrants a reconceptualization of the dietitian's role: not only as a provider of dietary plans, but as a facilitator of behavior change. Integrating psychoeducational techniques, motivational interviewing, and self-regulation strategies into dietary counseling may enhance patients' ability to manage stress without resorting to maladaptive eating⁵⁸. These approaches are most effective when implemented collaboratively with mental health professionals, whose expertise in stress regulation and behavioral adaptation is critical to sustaining dietary adherence and improving quality of life. Cognitive behavioral therapy and mindfulness-based interventions have shown particular promise in this context^{59,60}. Gastroenterologists, often the first point of contact in IBD care, are well-positioned to identify psychological distress and maladaptive eating patterns. Their active role in recognizing and addressing these issues can facilitate timely multidisciplinary referrals and foster holistic care. From a systems perspective, recognizing stress-eating and emotional dysregulation as cross-cutting therapeutic targets may streamline psychosocial assessment and intervention, although implementation may be constrained by time and resource limitations in routine practice. Overall, these findings underscore the importance of embedding mental health professionals as integral members of the IBD care team. Future research should investigate whether specific profiles of stress vulnerability or emotion-driven eating help identify patients who may benefit most from integrated psychological and behavioral support.

What sets this study apart is its integrative lens, which bridges psychological, nutritional, and clinical dimensions to uncover the behavioral mechanisms underlying disease progression. While the individual roles of diet and psychological distress in IBD are well-documented^{7,18}, the interaction between these domains remains underexplored. By demonstrating that comfort food consumption is more frequent during stress and that this behavior is modestly associated with greater self-reported disease activity, our findings suggest a potential behavioral pathway linking stress-related eating patterns with symptom perception rather than direct disease outcomes. Furthermore, the large sample size, recruitment through a national patient organization, the use of validated psychometric instruments, and the incorporation of carefully developed and pilot-tested dietary behavior items strengthen both the internal consistency and ecological validity of the findings. Beyond its empirical findings, the study can be situated within the broader framework of patient engagement, which conceptualizes patients as active participants in managing their health rather than passive recipients of care. By emphasizing subjective perceptions and self-reported outcomes, this work operationalizes a key principle of the patient engagement paradigm: integrating the patient's voice and lived experience into the understanding

of disease mechanisms and management strategies. Through the use of PROMs, the study highlights that patients' experiential knowledge provides valuable insights into the psychological and behavioral processes that accompany IBD. Strengthening engagement-oriented approaches in clinical practice may foster greater emotional awareness, self-regulation, and adherence, ultimately enhancing patients' capacity to manage stress and make health-promoting choices in daily life.

Several limitations should be acknowledged when interpreting these findings. The cross-sectional design precludes causal inference regarding the directionality of associations among perceived stress, comfort food consumption, and disease activity; longitudinal or experimental studies are needed to clarify these temporal relationships. All variables were self-reported, introducing potential recall and social desirability biases, particularly relevant for stress and dietary behaviors. Although validated instruments and pilot-tested ad hoc items were used, the assessment of comfort food consumption did not include portion size, caloric content, or contextual factors such as meal timing or social setting. Future studies incorporating ecological momentary assessment, 24-hour dietary recalls, or food diaries could enhance precision and ecological validity. The sample, though large and geographically diverse, was recruited through a patient association, which may have led to selection bias favoring more health-engaged individuals, thereby limiting generalizability. Confounding factors such as medication use, sleep quality, physical activity, and socioeconomic status were not assessed, constraining the ability to isolate the observed associations. Further, the PSS-10 was adapted to assess perceived stress over the preceding seven days to align with other measures, which may reduce comparability with studies using the standard four-week timeframe.

Disease-related variables also carry essential limitations. Stool consistency, measured via the Bristol Stool Chart, may have been influenced by prior surgical interventions (e.g., ileocecal resection, J-pouch formation) that were not systematically documented. Although surgical history was collected, it was recorded only as a binary variable, without details regarding disease subtype, surgery type, or timing. As these factors may differentially affect both clinical symptoms and stool consistency, we did not conduct subgroup analyses, as such comparisons would not yield clinically interpretable results. Furthermore, the lack of objective biomarkers of inflammation (e.g., C-reactive protein, fecal calprotectin) and the absence of clinical remission data limit the interpretation of gastrointestinal symptoms, which could reflect either inflammatory activity or stress-related functional responses. Likewise, the absence of a non-IBD control group prevents comparison with stress-induced gastrointestinal symptoms in the general population. Given that stress can elicit gastrointestinal disturbances such as loose stools and abdominal discomfort even in individuals without IBD, the observed associations should be interpreted with caution and understood as correlational rather than indicative of active inflammation.

Finally, the study did not include a baseline assessment of habitual dietary patterns, restricting the ability to distinguish momentary stress-related eating from long-term dietary behaviors that more strongly influence disease activity. The cultural specificity of the Italian sample also presents both a strength and a limitation: while offering a unique context to explore the emotional and symbolic meanings of food, it constrains the generalizability of findings to other sociocultural settings. Future cross-cultural and longitudinal studies incorporating biological, behavioral, and contextual measures are warranted to elucidate the complex interplay between psychological stress, eating behavior, and IBD activity.

Conclusion

In conclusion, this study contributes to a more comprehensive understanding of how psychological stress and dietary behaviors may relate to clinical outcomes in individuals with IBD. The findings suggest that higher levels of perceived stress are associated with greater consumption of comfort foods and increased symptom burden, including higher disease activity and softer stool consistency. While the associations observed were modest, they point to the relevance of considering both emotional and behavioral factors in the context of chronic disease management. These insights highlight the importance of holistic care approaches that help patients navigate the emotional and dietary challenges of living with IBD. Further research employing longitudinal designs and including culturally diverse populations may help disentangle the temporal relationships between stress, dietary behaviors, and symptom patterns to inform the development of context-sensitive support strategies for individuals with IBD.

Data availability

Due to privacy and ethical restrictions, the datasets generated and/or analyzed during the current study are not publicly available, but they are available from the corresponding author upon reasonable request.

Received: 27 August 2025; Accepted: 18 November 2025

Published online: 13 December 2025

References

- Johansen, I. et al. Symptoms and symptom clusters in patients newly diagnosed with inflammatory bowel disease: Results from the IBSEN III Study. *BMC Gastroenterol.* **23**, 255. <https://doi.org/10.1186/s12876-023-02889-y> (2023).
- Kaplan, G. G. & Windsor, J. W. The four epidemiological stages in the global evolution of inflammatory bowel disease. *Nat. Rev. Gastroenterol. Hepatol.* **18**, 56–66. <https://doi.org/10.1038/s41575-020-00360-x> (2021).
- Eugenicos, M. P. & Ferreira, N. B. Psychological factors associated with inflammatory bowel disease. *Br. Med. Bull.* **138**, 16–28. <https://doi.org/10.1093/bmb/ldab010> (2021).
- Varma, A. et al. Patient-reported impact of symptoms in Crohn's disease. *Am. J. Gastroenterol.* **117**, 2033–2045. <https://doi.org/10.14309/ajg.0000000000001954> (2022).
- Ananthakrishnan, A. N. et al. Environmental triggers in IBD: A review of progress and evidence. *Nat. Rev. Gastroenterol. Hepatol.* **15**, 39–49. <https://doi.org/10.1038/nrgastro.2017.136> (2018).

6. Campmans-Kuijpers, M. J. E. & Dijkstra, G. Food and food groups in inflammatory bowel disease (IBD): The design of the Groningen anti-inflammatory diet (GrAID). *Nutrients* **13**, 1067. <https://doi.org/10.3390/nu13041067> (2021).
7. Yan, J. et al. Dietary patterns and gut microbiota changes in inflammatory bowel disease: Current insights and future challenges. *Nutrient* **14**, 4003. <https://doi.org/10.3390/nu14194003> (2022).
8. Peters, V. et al. Dietary intake pattern is associated with occurrence of flares in IBD patients. *J. Crohn's Colitis* **15**, 1305–1315. <https://doi.org/10.1093/ecco-jcc/jjab008> (2021).
9. Tayyem, R. F., Qalqili, T. R., Ajeen, R. & Rayyan, Y. M. Dietary patterns and the risk of inflammatory bowel disease: Findings from a case-control study. *Nutrient* **13**, 1889. <https://doi.org/10.3390/nu13061889> (2021).
10. Khalili, H. et al. Adherence to a Mediterranean diet is associated with a lower risk of later-onset Crohn's disease: Results from two large prospective cohort studies. *Gut* **69**, 1637–1644. <https://doi.org/10.1136/gutjnl-2019-319505> (2020).
11. Radford, S. J., McGing, J., Czuber-Dochan, W. & Moran, G. Systematic review: the impact of inflammatory bowel disease-related fatigue on health-related quality of life. *Front. Gastroenterol.* **12**, 11–21 (2021).
12. Graffigna, G. & Barello, S. How does patient engagement work in a real-world setting? Recommendations, caveats, and challenges from a psychosocial perspective. *Patient. Educ. Couns.* **105**, 3567–3573 (2022).
13. Click, B., Cross, R. K., Regueiro, M. & Keefer, L. The IBD clinic of tomorrow: holistic, patient-centric, and value-based care. *Clin. Gastroenterol. Hepatol.* **23**, 419–427 (2025).
14. Peppas, S. et al. The brain-gut axis: Psychological functioning and inflammatory bowel diseases. *J. Clin. Med.* **10**, 377. <https://doi.org/10.3390/jcm10030377> (2021).
15. Fairbrass, K. M. et al. Bidirectional brain-gut axis effects influence mood and prognosis in IBD: A systematic review and meta-analysis. *Gut* **71**, 1773–1780. <https://doi.org/10.1136/gutjnl-2021-325985> (2022).
16. de Dios-Duarte, M. J. et al. Flare-ups in Crohn's disease: Influence of stress and the external locus of control. *Int. J. Environ. Res. Public Health* **19**, 13131. <https://doi.org/10.3390/ijerph192013131> (2022).
17. Acampora, M. et al. P1213 The role of stress in dietary choices and disease outcomes in inflammatory bowel disease. *J. Crohn's Colitis* **19**, i2198. <https://doi.org/10.1093/ecco-jcc/jjae190.1387> (2025).
18. Meule, A., Reichenberger, J. & Blechert, J. Development and preliminary validation of the salzburg stress eating scale. *Appetite* **120**, 442–448. <https://doi.org/10.1016/j.appet.2017.10.003> (2018).
19. Reichenberger, J., Pannicke, B., Arend, A.-K., Petrowski, K. & Blechert, J. Does stress eat away at you or make you eat? EMA measures of stress predict day to day food craving and perceived food intake as a function of trait stress-eating. *Psychol. Health* **36**, 129–147. <https://doi.org/10.1080/08870446.2020.1781122> (2021).
20. Klatzkin, R. R., Nolan, L. J. & Kissileff, H. R. Self-reported emotional eaters consume more food under stress if they experience heightened stress reactivity and emotional relief from stress upon eating. *Physiol. Behav.* **243**, 113638. <https://doi.org/10.1016/j.physbeh.2021.113638> (2022).
21. Jurek, J. M. & Maruda, A. The role of emotional eating as relief mechanism from psychological distress and its impact on overall wellbeing. *Debat. Psiquiatr.* <https://doi.org/10.25118/2763-9037.2024.v14.1268> (2024).
22. Ling, J. & Zahry, N. R. Relationships among perceived stress, emotional eating, and dietary intake in college students: Eating self-regulation as a mediator. *Appetite* **163**, 105215. <https://doi.org/10.1016/j.appet.2021.105215> (2021).
23. Wall Emerson, R. Regression and effect size. *J. Vis. Impair. Blind.* **117**, 191–192. <https://doi.org/10.1177/0145482X231166596> (2023).
24. Funder, D. C. & Ozer, D. J. Evaluating effect size in psychological research: Sense and nonsense. *Adv. Method. Pract. Psychol. Sci.* <https://doi.org/10.1177/2515245919847202> (2019).
25. Beaton, D. E., Bombardier, C., Guillemin, F. & Ferraz, M. B. Guidelines for the process of cross-cultural adaptation of self-report measures. *Spine* **25**, 3186–3191. <https://doi.org/10.1097/00007632-200012150-00014> (2000).
26. Sexton, K. A. et al. The inflammatory bowel disease symptom inventory: A patient-report scale for research and clinical application. *Inflamm. Bowel Dis.* **25**, 1277–1290. <https://doi.org/10.1093/ibd/izz038> (2019).
27. Lewis, S. J. & Heaton, K. W. Stool form scale as a useful guide to intestinal transit time. *Scand. J. Gastroenterol.* **32**, 920–924. <https://doi.org/10.3109/00365529709011203> (1997).
28. Blake, M. R., Raker, J. M. & Whelan, K. Validity and reliability of the Bristol Stool Form Scale in healthy adults and patients with diarrhoea-predominant irritable bowel syndrome. *Aliment. Pharmacol. Ther.* **44**, 693–703. <https://doi.org/10.1111/apt.13746> (2016).
29. Cohen, S., Kamarck, T. & Mermelstein, R. A global measure of perceived stress. *J. Health Soc. Behav.* **24**, 385–396. <https://doi.org/10.2307/2136404> (1983).
30. Mondo, M., Sechi, C. & Cabras, C. Psychometric evaluation of three versions of the Italian perceived stress scale. *Curr. Psychol.* **40**, 1884–1892. <https://doi.org/10.1007/s12144-019-0132-8> (2021).
31. Blanca Mena, M. J., Alarcón Postigo, R., Arnau, J., Bono, R. & Bendayan, R. Non-normal data: Is ANOVA still a valid option?. *Psicothema* <https://doi.org/10.7334/psicothema2016.383> (2017).
32. Araki, M. et al. Psychologic stress and disease activity in patients with inflammatory bowel disease: A multicenter cross-sectional study. *PLoS ONE* **15**, e0233365. <https://doi.org/10.1371/journal.pone.0233365> (2020).
33. Fakhfour, G., Mijailović, N. R. & Rahimian, R. Psychiatric comorbidities of inflammatory bowel disease: It is a matter of microglia's gut feeling. *Cells* **13**, 177. <https://doi.org/10.3390/cells13020177> (2024).
34. Nadeem, A. et al. Early onset active inflammatory bowel disease is associated with psychiatric comorbidities: A multi-network propensity-matched cohort study Crohn's. *Colitis* <https://doi.org/10.1093/crocol/otae066> (2025).
35. Salem, D. A. et al. Sex-related differences in profiles and clinical outcomes of inflammatory bowel disease: A systematic review and meta-analysis. *BMC Gastroenterol.* **24**, 425. <https://doi.org/10.1186/s12876-024-03514-2> (2024).
36. Akoglu, H. User's guide to correlation coefficients. *Turk. J. Emerg. Med.* **18**, 91–93. <https://doi.org/10.1016/j.tjem.2018.08.001> (2018).
37. Wadan, A.-H.S., El-Aziz, M. K. A. & Ellakwa, D.-E.S. The microbiota-gut-brain-axis theory: Role of gut microbiota modulators (GMMs) in gastrointestinal, neurological, and mental health disorders. *Naunyn Schmiedeberg's Arch. Pharmacol.* <https://doi.org/10.1007/s00210-025-04155-2> (2025).
38. Bonaz, B., Sinniger, V. & Pellissier, S. Role of stress and early-life stress in the pathogeny of inflammatory bowel disease. *Front. Neurosci.* **18**, 1458918. <https://doi.org/10.3389/fnins.2024.1458918> (2024).
39. Chen, Y. et al. Effects of psychological stress on inflammatory bowel disease via affecting the microbiota-gut-brain axis. *Chin. Med. J.* **138**, 664–677. <https://doi.org/10.1097/CM9.0000000000003389> (2025).
40. Whelan, K., Bancil, A. S., Lindsay, J. O. & Chassaing, B. Ultra-processed foods and food additives in gut health and disease. *Nat. Rev. Gastroenterol. Hepatol.* **21**, 406–427. <https://doi.org/10.1038/s41575-024-00893-5> (2024).
41. Luo, K. et al. From gut inflammation to psychiatric comorbidity: mechanisms and therapies for anxiety and depression in inflammatory bowel disease. *J. Neuroinflammation.* **22**, 149. <https://doi.org/10.1186/s12974-025-03476-6> (2025).
42. Obara-Golebiowska, M. Early maladaptive schemas, emotion regulation, stress, social support, and lifestyle factors as predictors of eating behaviors and diet quality: Evidence from a large community sample. *Nutrient.* **17**, 3188. <https://doi.org/10.3390/nu17203188> (2025).
43. Gupta, A., Osadchij, V. & Mayer, E. A. Brain-gut-microbiome interactions in obesity and food addiction. *Nat. Rev. Gastroenterol. Hepatol.* **17**, 655–672. <https://doi.org/10.1038/s41575-020-0341-5> (2020).

44. Bostan, A., Balcioglu, Y. S. & Elçi, M. Latent class analysis of environmental behavior and psychological well-being: Insights into sustainable well-being practices. *Sustainability*. **16**, 10205. <https://doi.org/10.3390/su162310205> (2024).
45. Goldstein, E., Brown, R. L., Lennon, R. P. & Zgierska, A. E. Latent class analysis of health, social, and behavioral profiles associated with psychological distress among pregnant and postpartum women during the COVID-19 pandemic in the United States. *Birth* **50**, 407–417. <https://doi.org/10.1111/birt.12664> (2023).
46. Obbarius, N., Fischer, F., Liegl, G., Obbarius, A. & Rose, M. A modified version of the transactional stress concept according to Lazarus and Folkman was confirmed in a psychosomatic inpatient sample. *Front. Psychol.* **12**, 584333. <https://doi.org/10.3389/fpsyg.2021.584333> (2021).
47. Engel, F. et al. Higher levels of psychological burden and alterations in personality functioning in Crohn's disease and ulcerative colitis. *Front. Psychol.* **12**, 671493. <https://doi.org/10.3389/fpsyg.2021.671493> (2021).
48. Mitropoulou, M.-A. et al. Quality of life in patients with inflammatory bowel disease: Importance of psychological symptoms. *Cureus* **14**, e28502. <https://doi.org/10.7759/cureus.28502> (2022).
49. Barberio, B., Zamani, M., Black, C. J., Savarino, E. V. & Ford, A. C. Prevalence of symptoms of anxiety and depression in patients with inflammatory bowel disease: A systematic review and meta-analysis. *Lancet Gastroenterol. Hepatol.* **6**, 359–370. [https://doi.org/10.1016/S2468-1253\(21\)00014-5](https://doi.org/10.1016/S2468-1253(21)00014-5) (2021).
50. McAtamney, K., Mantzios, M., Egan, H. & Wallis, D. J. A systematic review of the relationship between alexithymia and emotional eating in adults. *Appetite* **180**, 106279. <https://doi.org/10.1016/j.appet.2022.106279> (2022).
51. Reichenberger, J., Schnepfer, R., Arend, A.-K. & Blechert, J. Emotional eating in healthy individuals and patients with an eating disorder: Evidence from psychometric, experimental and naturalistic studies. *Proc. Nutr. Soc.* **79**, 290–299. <https://doi.org/10.1017/S0029665120007004> (2020).
52. Castellini, G., Bryant, E. J., Stewart-Knox, B. J. & Graffigna, G. Development and validation of the psychological food involvement scale (PFIS). *Food Qual. Prefer.* **105**, 104784. <https://doi.org/10.1016/j.foodqual.2022.104784> (2023).
53. Tatoli, R. et al. Dietary customs and social deprivation in an aging population from Southern Italy: A machine learning approach. *Front. Nutr.* **9**, 811076. <https://doi.org/10.3389/fnut.2023.1186961> (2022).
54. Rokach, A. Belonging, togetherness, and food rituals. *Open J. Depress.* **9**, 77. <https://doi.org/10.4236/ojd.2020.94007> (2020).
55. Moro, E., Galletti, R. Sharing food and conviviality in the Mediterranean diet: Some ethnographic examples. In *Making Food in Local and Global Contexts* (ed. Nobayashi, A.) 71–87 https://doi.org/10.1007/978-981-19-1048-7_5 (Springer, 2022).
56. Markey, C. H. et al. A survey of eating styles in eight countries: Examining restrained, emotional, intuitive eating and their correlates. *Br. J. Health Psychol.* **28**, 136–155. <https://doi.org/10.1111/bjhp.12616> (2023).
57. Svolos, V. et al. ECCO consensus on dietary management of inflammatory bowel disease. *J. Crohns Colitis*. <https://doi.org/10.1093/ecco-jcc/jjaf122> (2025).
58. Spring, B., Champion, K. E., Acabchuk, R. & Hennessy, E. A. Self-regulatory behaviour change techniques in interventions to promote healthy eating, physical activity, or weight loss: A meta-review. *Health Psychol. Rev.* **15**, 508–539. <https://doi.org/10.1080/17437199.2020.1721310> (2021).
59. Chen, J. et al. The physiological and psychological effects of cognitive behavior therapy on patients with inflammatory bowel disease before COVID-19: A systematic review. *BMC Gastroenterol.* **21**, 469. <https://doi.org/10.1186/s12876-021-02003-0> (2021).
60. Naude, C. et al. The effectiveness of mindfulness-based interventions in inflammatory bowel disease: A systematic review & meta-analysis. *J. Psychosom. Res.* **169**, 111232. <https://doi.org/10.1016/j.jpsychores.2023.111232> (2023).

Acknowledgements

The authors would like to acknowledge the Italian IBD patient organization A.M.I.C.I. ETS for supporting the data collection.

Author contributions

DU, MA, ACP, MS, MSDR, LA, SL, and GG designed the study. DU, MA, and SL collected the data. DU, MA, ACP, MS, MSDR, LA, and GG conducted the data analysis. DU, MA, ACP, and MS prepared the manuscript. MSDR, LA, SL, and GG critically revised and supervised the manuscript. All the authors have approved the final version of the manuscript.

Funding

This work was supported by the European Union under the Horizon Europe [grant agreement number 101095470 - miGut-Health-HLTH-2022-STAYHLTH-02-01: Personalised blueprint of chronic inflammation in health-to-disease transition] and from the Swiss State Secretariat for Education, Research and Innovation (SERI) [contract number 22.00445]. Views and opinions expressed are, however, those of the authors only and do not necessarily reflect those of the European Union nor European Health and Digital Executive Agency (HaDEA). Neither the European Union nor HaDEA can be held responsible for them.

Declarations

Competing interests

The authors declare no competing interests.

Additional information

Supplementary Information The online version contains supplementary material available at <https://doi.org/10.1038/s41598-025-29573-3>.

Correspondence and requests for materials should be addressed to D.U.

Reprints and permissions information is available at www.nature.com/reprints.

Publisher's note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Open Access This article is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License, which permits any non-commercial use, sharing, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if you modified the licensed material. You do not have permission under this licence to share adapted material derived from this article or parts of it. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by-nc-nd/4.0/>.

© The Author(s) 2025

miGut-Health consortium

**Andre Franke⁶, Jurgita Skiecevičienė⁷, Samuel Huber⁸, Rinse Weersma⁹, Eran Segal¹⁰,
Guendalina Graffigna^{1,2}, Verena Gluschak¹¹, Jonas Halfvarsson¹², Johan Burisch¹³, Luisa
Avedano⁴ & Marcel Salathé¹⁴**

⁶University Hospital Schleswig-Holstein, Kiel, Germany. ⁷Lithuanian University of Health Sciences, Kaunas, Lithuania. ⁸University Medical Center Hamburg-Eppendorf, Hamburg, Germany. ⁹University Medical Center Groningen, Groningen, Netherlands. ¹⁰Weizmann Institute of Science, Rehovot, Israel. ¹¹Eurice European Research and Project Office GmbH, St. Ingbert, Germany. ¹²Örebro University, Örebro, Sweden. ¹³Hvidovre Hospital, Region Hovedstaden, Hvidovre, Denmark. ¹⁴École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland.