

ARE WOMEN LESS WILLING TO CHANGE? THE INFLUENCE OF STRESS, ANXIETY AND DEPRESSION IN GASTROINTESTINAL SYMPTOMS

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ARE WOMEN LESS WILLING TO CHANGE? THE INFLUENCE OF STRESS, ANXIETY AND DEPRESSION IN GASTROINTESTINAL SYMPTOMS. (Abstract) The nutritional profile of an individual constitutes one of the main regulators of gastrointestinal physiology and psychological well-being. This study **aimed** to identify the presence of gastrointestinal symptoms in medical students, health-related behaviors, and their relationship with the presence of stress, anxiety, and depression. **Materials and methods:** a total of 152 students from all years of study were included in the study. The respondents had to fill in an online questionnaire. Sociodemographic and medical related data as well as information about diet, nutritional status, quality of life and health-related behaviors were gathered. Psychological status was assessed using the *DASS-21*. Eating habits were evaluated using the *Rapid Eating Assessment for Participants*, while gastrointestinal symptom severity and impact on daily life were measured using the *Visual Analogue Scale for Irritable Bowel Syndrome* (VAS-IBS). Statistical analyses were performed using *IBM Statistical Package for Social Sciences* (SPSS) Statistics for Windows, version 24 (SPSS Inc., Chicago, IL, USA). **Results:** The mean age of participants was 21.28 ± 1.93 years (range: 18-25). More than half stated that they noticed changes in digestion when experiencing fatigue or poor sleep, with frequent changes observed in 27.6% of participants (N = 42). Most participants showed normal levels of stress (88.2%), depression (75%), or anxiety (74.3%). The results on the Food Sufficiency subscale revealed that most participants (71.71%, N = 109) did not eat enough, and did not have an adequate intake of daily meals, proteins, and calcium-rich foods. Additionally, the results of the Healthy Eating subscale showed that most participants (93.4%, N = 142) had insufficient consumption of healthy foods. In contrast, the results on the Low Nutrient Density Foods subscale showed that most participants (88.81%, N = 135) reported limited consumption of foods with low nutritional density, and therefore a more favorable eating behavior. Women demonstrated significantly lower results in terms of willingness to change ($M = 1.71 \pm 0.68$) compared to men ($M = 2.00 \pm 0.75$). **Conclusions:** The data obtained indicated that stress is the main predictor of the severity of gastrointestinal symptoms, while food sufficiency exerted a protective effect. A more adequate diet was associated with reduced symptoms of Irritable Bowel Syndrome. These results show the importance of psychological factors and the quality of food in the quality of life of the young population. **Keywords:** STRESS, ANXIETY, DEPRESSION, MEDICAL STUDENTS, GASTROINTESTINAL SYMPTOMS, SLEEP, DIET, NUTRITIONAL STATUS, PHYSICAL ACTIVITY.

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INTRODUCTION

Contemporary psychobiological research has increasingly explored the bidirectional relationship between mental health and somatic functioning, with particular emphasis on the mechanisms underlying the gut-brain axis (1-3). This axis represents a neurohormonal network that connects the enteric nervous system with the central nervous system and provides a psychological framework for the recurrent comorbidity identified between psychological distress and gastrointestinal dysfunction (4). The prevalence of mental health issues is rising in the young adult population, and the mechanisms by which these psychological factors manifest as physical symptoms remain multifactorial. Psychological distress is most commonly operationalized through stress, anxiety, and depression, each exerting specific physiological effects on gastrointestinal homeostasis. Stress, characterized as an integrated physiological and psychological response to actual or perceived threats, involves the central nervous system response. Chronic or excessive activation of key brain regions contributes to emotional dysregulation, excessive visceral sensitivity and disturbances in gastrointestinal function (5).

Although anxiety is a natural adaptive response to stress, when it becomes persistent, excessive, or disproportionate, it may develop into an anxiety disorder, one of the most prevalent classes of mental health conditions worldwide (6). In 2021, it affected more than 359 million people, with a notably higher prevalence in women than in men. Similarly, depression affected approximately 332 million people in the same year, being 1.5 times more common in women than in men (7). The development

of both depression and anxiety disorders is influenced by a multifactorial interplay between biological, psychological, social, and environmental factors. Consequently, these affective disturbances interact with the gastrointestinal system through specific neuroimmune pathways, linking psychological dysregulation to somatic impairments.

Growing evidence indicates that this association is modulated by modifiable lifestyle factors such as nutritional habits, sleep quality, and physical activity (8-10). The nutritional profile of an individual represents one of the main regulators of gastrointestinal physiology and psychological well-being. Contemporary dietary patterns among young adults frequently exhibit a "Westernized" profile, characterized by high intake of processed foods, with limited nutrient density (11). Despite high caloric consumption, these dietary patterns remain deficient in essential macro- and micronutrients required for proper nervous system functioning. Furthermore, the consumption of vegetables and cereal products rich in dietary fiber and essential nutrients remains insufficient (12). Increasing evidence suggests that adequate nutrient intake exerts a protective effect against systemic inflammation while preserving gastrointestinal motility and function (13).

In contrast, the consumption of low-quality food has been associated not only with the exacerbation of functional gastrointestinal symptoms but also with the intensification of anxiety and depressive states through neuroimmune pathways. Consequently, diet may function as a critical mediator whereby psychological distress may promote maladaptive eating behaviors, ultimately undermining gastrointestinal health and creating a vicious cyclic

pattern (14). However, nutrition must be considered within the broader framework of lifestyle-related health determinants. The prevalence of physical inactivity and sleep disturbances has increased in recent decades, with both factors demonstrating independent and codependent associations with obesity and alterations in gut microbiota composition (15, 16). According to Zhu and Huang (17), a physiological state of sleep improves metabolism and immunity, whereas sleep deprivation promotes hyperalgesia, affecting neurobiological systems and mediators that simultaneously impair emotional regulation.

Similarly, physical activity modulates autonomic nervous system balance and the endocrine responses. Sedentarism has been associated with increased sympathetic activity, anxiety, depression and gastrointestinal dysfunction vulnerability (18). Despite extensive research examining these factors individually, integrative approaches that evaluate the synergistic effects of sleep, diet, and physical activity in relation to stress, anxiety, and depression-and their cumulative impact on gastrointestinal health in non-clinical populations-remain underdeveloped.

In recent years, dysregulation of the bidirectional brain-gut axis has been increasingly recognized as a central framework for understanding the pathophysiology of Irritable Bowel Syndrome (IBS), which is characterized by abnormal functioning of the enteric, autonomic, and central nervous systems (19). The comorbidity between IBS and psychiatric diseases, such as anxiety and depression, has been individualized in up to 60% of patients (20). While the connection between Irritable Bowel Syndrome and stress is well documented through its impact on the intestinal sensi-

tivity, secretion, motility, and permeability, the behavioral pathways underpinning this association require further elucidation. The extent to which negative emotional states affect gastrointestinal health directly or through mediated changes in lifestyle habits remains insufficiently understood. A thorough understanding of these dynamics is essential for the development of holistic health strategies aimed at the 18 to 25-year-old population. The present study aimed to characterize the multidimensional interplay between lifestyle behaviors, psychological functioning and gastrointestinal health in a young adult population. The central aim was to evaluate the extent to which dietary behaviors, defined by both nutrient sufficiency and dietary quality, mediate the impact of psychological distress on the intensity of gastrointestinal symptoms.

MATERIALS AND METHODS

Study Population. The participants were selected using the snowball method between. The study was developed during October and November 2025. The inclusion criterion in the study was the completion of the questionnaire before the submission deadline. Questionnaires were distributed to medical science students, from all years of study. The respondents were informed about the purpose of the research and the use of the collected data. No incentives were offered. Finally, 152 questionnaires were included in the study.

Data collection. The questionnaire was constructed using Google Forms (Alphabet, Mountain View, CA, USA).

a. The first part of the questionnaire collected socio-demographic and lifestyle-related data (such as age, gender, environment of origin, Body Mass Index - BMI, religion, adherence to religious fasting

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practices, smoker/non-smoker status, consumption of psychoactive substances, number of hours of sleep per night, self-assessment of sleep quality, and engagement in physical activities).

b. The second section of the questionnaire included information about the participants' health status (diagnosis of gastroesophageal reflux disease, irritable bowel syndrome, and respiratory, gastric, or intestinal infections, as well as the frequency of medication use. Information was also collected regarding the use of medication or dietary supplements, such as antibiotics, magnesium, zinc, vitamin E, supplements, B vitamins, and omega-3/omega-6 supplements. Additionally, the participants reported the type of diet they followed, including Mediterranean, DASH, Nordic, Japanese, traditional Romanian, keto, oligoantigenic, or vegetarian/vegan diet.

c. The third section included a psychological questionnaire designed to measure negative emotional states which can have a major influence on the health status of the participants - *DASS-21* (21). The questionnaire was a set of three self-rating scales that indicated the severity of core symptoms in the domains of depression, anxiety, and stress. The DASS score was calculated by summing the responses to the items of each subscale, with each item rated on a Likert scale from 0 ("Not at all") to 3 ("Applied very much or almost all of the time").

d. The next part of the questionnaire used a tool that quickly assessed the participants' eating habits - *Rapid Eating Assessment for Participants, 21 questions - REAP v.2* (22). This instrument is an updated and validated dietary screener designed to quickly assess a patient's eating behaviors, dietary patterns, and readiness to

change. The questionnaire included five subscales: Food Sufficiency, Healthy Eating, Intake of Low-Nutrient Foods, Exercise and Willingness to Change. The response options were "Every day", "More than two times a week" or "More than three times a week" (depending on the item), "Two or fewer times a week" or "Three or fewer times a week" and "Never". The score assigned to the response options ranged from 0 to 3 points. The highest possible score for REAP v.2 is 60 points. Although higher numbers generally represent healthier habits, a given person might be high on one subscale and low on another.

e. The final part of the survey included a self-report tool designed to measure the severity of gastrointestinal symptoms and their impact on a patient's life - *The Visual Analogue Scale for Irritable Bowel Syndrome (VAS-IBS)* (23). It consists of seven visual analogue scales assessing pain, diarrhea, constipation, bloating, vomiting/nausea, psychological well-being, and the influence of intestinal symptoms on daily life. Each item received a score from 1 (*maximum perceived severity*) to 10 (*absence of symptoms*). Two additional items, if the subject experienced defecation urgency or a sensation of incomplete evacuation when defecating (*yes* or *no*).

In addition, at the end of the questionnaire, several items were added to assess whether certain foods had a perceived negative effect on the diet, and which ones, whether changes in digestion were observed when participants were tired or slept poorly, as well as digestive symptoms that occurred during stressful periods.

Statistical analysis. All statistical analyses for this research were performed using *IBM Statistical Package for Social*

Sciences (SPSS) Statistics for Windows, version 24 (SPSS Inc., Chicago, IL, USA). Results for descriptive statistics were expressed as means and standard deviations (SD).

The normality of data distribution was tested using the Kolmogorov-Smirnov test. Given that the data were partially normally distributed, parametric tests were applied. To assess the comparative results considering gender and diagnosis of a chronic disease, the Independent Sample t-Test was performed.

Pearson's correlation coefficient was used to test the relationship between variables. A p -value < 0.05 was considered statistically significant. A multiple mediation analysis was also conducted to explore the role of Food Sufficiency and Low-Density Nutrient Foods as mediators between stress and gastrointestinal symptoms. The PRO-CESS procedure for SPSS, developed by Andrew F. Hayes, was used to test this model. The statistical significance threshold was set at $p < 0.05$, which ensured a rigorous interpretation of the results.

Ethical approval. The study was conducted in accordance with the Declaration of Helsinki, and the protocol was approved by the Ethical Committee of Prolife Clinics Iași, Romania, No.74/03.07.2025.

RESULTS

Socio-demographic and lifestyle-related data

The participants aged $M = 21.28 \pm 1.93$, with ages ranging from 18 to 25 years. Most participants were women (76.3%, $N = 116$) and more than a half originated from urban areas (66.4%, $N = 101$).

Regarding weight status calculated according to Body Mass Index (BMI), more than half of the participants had a normal

weight (63.8%, $N = 97$), less than one quarter were overweight (23%, $N = 35$), and a smaller proportion (9.9%, $N = 15$) were underweight, with BMI values below the WHO limit of 18.5 kg/m^2 . The results showed that most participants were Orthodox Christians (78.9%, $N = 120$). More than half said they did not fast (63.8%, $N = 97$), while one quarter reported adherence to Orthodox Christian fasting periods (25.7%, $N = 39$). More than half of the participants were non-smokers (56.6%, $N = 86$), whereas one quarter declared that they smoked daily (25%, $N = 38$). Most of the participants did not consume psychoactive substances (90.8%, $N = 138$), while a small proportion consumed them occasionally (8.6%, $N = 13$). More than half of the participants reported sleeping between 5 and 7 hours per night (63.8%, $N = 97$) and more than a quarter slept between 7 and 9 hours per night (25.7%, $N = 39$). The quality of sleep during the night described by most participants was: "I sleep well, but sometimes I wake up" (50%, $N = 76$), "I sleep very well, without interruptions" (25%, $N = 38$), "I am a light sleeper and wake up often" (11.8%, $N = 18$).

Regarding physical activity, nearly half of the participants reported engaging in light physical activity occasionally (48.7%, $N = 74$), while one third reported performing moderate physical activity several days a week (30.3%, $N = 46$).

Participants' health, digestion and diet status

The participants were asked about whether they had ever been diagnosed with any diseases related to the digestive system. Most participants reported no such diagnoses. However, a small proportion had been diagnosed with gastroesophageal

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reflux disease (7.2%, or 11 people) or irritable bowel syndrome (3.9%, or 6 people). Additionally, over one quarter of the participants (27.6%, N = 42) reported at least one episode of respiratory, gastric, or intestinal infection.

Regarding the use of medications and supplements, less than half of the participants (47.4%, N = 72) reported that they rarely used medications for any condition, while over one quarter reported monthly use (26.3%, N = 40). Within the previous 12 months, less than half of the participants reported antibiotic use (46.1%, N = 70). More than half of the participants used Magnesium supplements (52.6%, N = 80), and one third of the participants used Zinc supplements (33.6%, N = 51), B vitamins (35.5%, N = 54) or omega-3/omega-6 supplements (31.6%, N = 48). Vitamin E supplements were consumed by a small part of the participants (17.1%, N = 26).

Approximately one third of the participants reported following a traditional Romanian diet (31.6%, N = 48). Smaller proportions reported adherence to other diets: 9.9% (N = 15) followed a Vegetarian or Vegan diet, 7.9% (N = 12) chose a Mediterranean diet, and 3.9% (N = 6) consumed a Nordic diet.

Participants were asked whether there were certain foods that clearly affected their digestion. Responses were distributed

as follows: about one third said “never” (31.6%, N = 48), more than one quarter answered “yes, definitely” (25.7%, N = 39), and less than one quarter answered “sometimes” (23.7%, N = 36). Foods that triggered digestive disorders included dairy products (9.2%, N = 14), fast food and pastries (8.55%, N = 13), some fruits and vegetables such as bananas, tomatoes, peas, beans (6.57%, N = 10), but also sweetened or fizzy drinks (3.28%, N = 5).

Over half of the participants reported experiencing noticeable changes in digestion when they were fatigued or had insufficient sleep, with such changes occurring frequently (27.6%, N = 42) or occasionally (29.6%, N = 45). In addition, during stressful periods, participants manifested various digestive symptoms, with abdominal pain (33.6%, N = 51) or bloating (26.3%, N = 40) being the most commonly reported.

Depression, Anxiety, Stress Scale (DASS-21)

The scale demonstrated very good internal consistency, as determined by Cronbach’s alpha of 0.96. Analysis of the distribution of scores on the DASS-21 showed that approximately half of the participants had a normal level of stress (54.6%), depression (49.3%), or anxiety (44.1%) (tab. I).

TABLE I.
DASS-21 Severity Classification

	Normal	Mild	Moderate	Severe	Extremely severe
Stress	83 (54.6%)	21 (13.8%)	21 (13.8%)	14 (9.2%)	13 (8.6%)
Depression	75 (49.3%)	7 (4.6%)	40 (26.3%)	8 (5.3%)	22 (14.5%)
Anxiety	67 (44.1%)	16 (10.5%)	30 (19.7%)	11 (7.2%)	28 (18.4%)

Frequency and percentages (%)

Rapid Eating Assessment for Participants (REAP)

The Cronbach Alpha score was 0.54 for the total scale, 0.48 for *Food Sufficiency subscale*, 0.56 for *Healthy Eating Pattern subscale* and 0.66 for *Low Nutrient Density Foods subscale*. For these REAP subscales, as well as for the items related to *Physical Activity* and *Disponibility to Change* we obtained the following results:

- a. food sufficiency - $M = 6.24 \pm 2.45$,
- b. healthy eating pattern - $M = 9.16 \pm 3.22$,
- c. low nutrient density foods - $M = 21.93 \pm 3.66$,
- d. physical activity - $M = 2.30 \pm 0.92$,
- e. disponibility to change - $M = 1.78 \pm 0.71$.

The total REAP score was on average $M = 39.61 \pm 5.98$, with scores ranging from 21 (1.3%, $N = 2$) to 57 (0.7%, $N = 1$).

The results on the Food Sufficiency subscale indicated that most participants (71.71%, $N = 109$) did not eat enough, and did not have an adequate intake of daily meals, proteins and calcium-rich foods. Similarly, results on the Healthy Eating subscale showed that most participants (93.4%, $N = 142$) reported insufficient consumption of healthy foods. In contrast, the results on the Low Nutrient Density Foods subscale showed that most participants (88.81%, $N = 135$) demonstrated reduced consumption of foods with low nutritional density, indicating a more favorable eating behavior.

The Visual Analogue Scale for Irritable Bowel Syndrome (VAS-IBS). The total score for the VAS-IBS scale was $M = 53.59 \pm 14.44$, with values ranging from 10 (0.7%, $N = 1$) to 70 (10.5%, $N = 16$). Thus, the participants reported a low severity of

gastrointestinal symptoms and a relatively good quality of life.

Regarding the response to the last two items of the instrument, less than one quarter of the participants (23.7%, $N = 36$) stated that they had felt an urgency to defecate in the previous 2 weeks, and less than half of the participants (43.4%, $N = 66$) reported a sensation of incomplete bowel evacuation. The scale had good internal consistency, as determined by Cronbach's alpha of 0.86.

Comparative and correlational analysis. The independent samples t-test revealed the existence of significant gender differences in Body Mass Index of the participants ($t(150) = 4.15$, $p < 0.001$), with women exhibiting significantly lower BMI values ($M = 21.98 \pm 3.74$) compared to men ($M = 24.99 \pm 3.96$). In addition, significant differences were also identified in terms of the participants' willingness to change ($t(150) = 1.51$, $p = 0.03$). Women had significantly lower results in terms of willingness to change ($M = 1.71 \pm 0.68$) compared to men ($M = 2.00 \pm 0.75$).

Significant differences were identified between participants who received a positive diagnosis and those who did not have a diagnosis of irritable bowel syndrome in terms of physical activity levels ($t(150) = -2.17$, $p = 0.03$). Thus, those who were diagnosed with irritable bowel syndrome had a lower physical activity score ($M = 1.50 \pm 1.04$), compared to those who did not have this condition ($M = 2.33 \pm 0.91$).

The results of the comparative analysis showed that there were significant differences for the variable "positive/negative diagnosis for irritable bowel syndrome" in terms of stress ($t(150) = 3.84$, $p < 0.001$), depression ($t(150) = 4.27$, $p < 0.001$) and anxiety levels ($t(150) = 4.36$, $p < 0.001$),

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meaning that those with a positive diagnosis had a significantly higher score on all these psychological scales ($M = 31.00 \pm 11.91$ for stress, $M = 35.66 \pm 18.39$ for depression, respectively 26.66 ± 14.62 for anxiety) compared to those without this diagnosis ($M = 14.53 \pm 10.22$, $M = 13.19 \pm 12.37$, respectively 9.89 ± 8.98). The independent samples t-test indicated the existence of significant differences between participants who received a positive diagnosis and those who did not have a diagnosis of irritable bowel syndrome in terms of VAS-IBS scale results ($t(150) = -2.17$, $p = 0.03$). Thus, those who were diagnosed with irritable bowel syndrome had a lower VAS-IBS score ($M = 33.67 \pm 12.48$), compared to those who did not have this condition ($M = 54.40 \pm 13.96$).

Significant differences were identified between participants who consumed and those who did not consume antibiotics in terms of their willingness to change ($t(150) = 2.48$, $p = 0.01$). Those who reported antibiotic use in the previous 12 months demonstrated a significantly higher score on readiness for change ($M = 1.93 \pm 0.80$) than those who did not report antibiotic use ($M = 1.65 \pm 0.59$).

The results of the comparative analysis showed that there were significant differences for the variable "consumption of antibiotics" in terms of depression ($t(150) = 2.09$, $p = 0.03$) and VAS-IBS score ($t(150) = -2.76$, $p = 0.007$). Thus, those who had taken antibiotics in the previous 12 months had a significantly higher score on depression ($M = 14.65 \pm 12.86$) than those who had not ($M = 10.75 \pm 10.10$).

Moreover, those who had taken antibiotics in the previous 12 months had a lower score on the VAS-IBS scale and therefore, a greater severity of irritable bowel syn-

drome symptoms ($M = 50.06 \pm 16.60$) compared to those who had not taken antibiotics ($M = 56.60 \pm 11.52$).

The Pearson correlational analysis found a significant positive association between age and number of hours slept per night ($r = 0.17$, $p = 0.03$), indicating that older participants tended to report longer sleep duration.

The number of hours of sleep correlated negatively with the level of depression ($r = -0.19$, $p = 0.01$), meaning that increased nighttime sleep was associated with lower reported depression. Additionally, there were positive correlations between the number of hours of sleep per night and the scores on the REAP instrument subscale for Low Density Nutrient Foods ($r = 0.17$, $p = 0.03$), suggesting that longer sleep duration was linked to a greater tendency to consume foods low in nutritional density, such as fatty meats, solid fats, sweetened beverages, sweets, and processed snacks. The REAP section on Food Sufficiency correlated negatively with levels of stress ($r = -0.40$, $p < 0.001$), depression ($r = -0.43$, $p < 0.001$), and anxiety ($r = -0.42$, $p < 0.001$), meaning that the more satisfactory the diet, the lower the levels of stress, depression, and anxiety, respectively. Furthermore, Food Sufficiency correlated positively with gastrointestinal symptoms - as measured by VAS-IBS ($r = 0.36$, $p < 0.001$), indicating that the more satisfactory the diet, the less severe the gastrointestinal symptoms and the better the quality of life.

The REAP section on Low Nutrient Density Foods correlated negatively with levels of stress ($r = -0.22$, $p = 0.006$), depression ($r = -0.20$, $p = 0.10$), and anxiety ($r = -0.23$, $p = 0.003$), meaning that the more the participants consumed foods with low nutritional density, the lower the levels

of stress, depression, and anxiety, respectively. In addition, Low Nutrient Density Foods correlated positively with gastrointestinal symptoms ($r = 0.21$, $p = 0.007$), meaning that the more the participants consumed foods with low nutritional density, the less severe the gastrointestinal symptoms.

There was a negative correlation between the level of physical activity measured using the REAP instrument and the level of anxiety ($r = -0.20$, $p = 0.01$), indicating that the higher the level of physical activity, the lower the anxiety. The level of physical activity correlated positively with gastrointestinal symptoms ($r = 0.22$, $p = 0.005$), meaning that the more the participants exercised, the less severe the gastrointestinal symptoms were.

Readiness to change within the REAP instrument correlated negatively with gastrointestinal symptoms ($r = -0.21$, $p = 0.009$), meaning that the greater the participants' willingness to change their eating behavior, the greater the tendency for the severity of gastrointestinal symptoms to increase. A negative correlation existed between willingness to change and Food Sufficiency ($r = -0.21$, $p = 0.009$), meaning that the more interested the participants were in changing their eating behavior, the more their diet was less satisfying. In addition, willingness to change correlated positively with anxiety levels ($r = 0.24$, $p = 0.003$), meaning that the more the participants were interested in changing their eating behavior, the higher their anxiety levels.

A negative correlation was identified between anxiety levels and gastrointestinal symptoms ($r = -0.66$, $p < 0.001$), meaning that the higher the anxiety level, the greater the severity of gastrointestinal symptoms.

In addition, the level of stress ($r = -0.59$, $p < 0.001$) and depression ($r = -0.60$, $p < 0.001$) correlated negatively with gastrointestinal symptoms, indicating that the higher the stress and depression levels, the greater the severity of gastrointestinal symptoms.

Mediation analysis. A mediation analysis was conducted to test the mechanisms by which stress level influences the severity of digestive symptoms, considering several potential mediators, represented by the REAP subscales (Food Sufficiency, Low Nutrient Density Foods). The associations between the variables involved have already been analyzed. Thus, significant correlations were found between the two variables:

- a. food sufficiency was negatively associated with stress levels ($r = -0.40$) and positively associated with the severity of digestive symptoms ($r = 0.36$);
- b. stress level was negatively associated with gastrointestinal symptomatology ($r = -0.59$);
- c. low nutrient density foods was positively associated with gastrointestinal symptomatology ($r = 0.21$) and negatively with stress level ($r = -0.22$).

Linear regression analysis revealed the following results:

- a. stress significantly predicted digestive symptoms ($\beta = -0.10$, $p < 0.001$);
- b. stress significantly predicted food sufficiency ($\beta = -0.09$, $p < 0.001$);
- c. stress predicted low nutrient density foods ($\beta = -0.05$, $p = 0.048$);
- d. food sufficiency did not predict low nutrient density foods ($\beta = 0.19$, $p = 0.13$);

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- e. low Nutrient Density Foods did not predict digestive symptoms ($\beta = 0.29, p = 0.27$).

The data obtained indicated that stress was the main predictor of the severity of gastrointestinal symptoms. Food Sufficiency had a protective effect: a more adequate diet was associated with reduced symptoms of Irritable Bowel Syndrome (IBS). Low Nutrient Density Foods did not significantly contribute to gastrointestinal symptomatology in the presence of other variables.

In conclusion, the model did not support full serial mediation, but clearly supported simple mediation through Food Sufficiency. Although stress had a strong direct effect on IBS symptomatology, part of this effect was explained by changes in basic eating behavior.

While Food Sufficiency was found to mediate the effects of stress, similar analyses for anxiety and depression did not reveal any notable indirect effects. However, both anxiety and depression were significantly associated with gastrointestinal symptom severity, supporting their relevant role in the pathogenesis of IBS, through predominantly direct mechanisms. This suggests the involvement of distinct psychobiological mechanisms, independent of diet, in the relationship between anxiety, depression and gastrointestinal symptom severity.

DISCUSSION

This study investigated the multifactorial correlation between lifestyle factors, with particular emphasis on nutritional habits, psychological well-being, gut health and mental health. The results characterize a vulnerability profile in which psychological distress functions as a central catalyst

for both maladaptive eating behaviors and functional somatic symptomatology.

Data analysis revealed that different psychological factors exert a distinct influence on gastrointestinal health. While stress was identified as a direct predictor of gastrointestinal symptom severity, mediation analysis indicated that a portion of this effect was accounted for by changes in eating behavior, specifically Food Sufficiency. This implies that stress-related changes in nutrition can play a role in exacerbating gastrointestinal symptoms. Similar patterns have been observed in broader mental health studies. Madison and Kiecolt-Glaser (2019) reported that stress and depression affect gastrointestinal function both directly and indirectly through diet related behaviors (24). However, in our study, an indirect dietary influence, especially food insufficiency, was observed exclusively for stress, with no significant mediation identified for depression.

In contrast, anxiety and depression were predominantly associated with gastrointestinal symptoms through direct psychological mechanisms. These findings underscore the potential role of the neural and endocrine pathways of the gut-brain axis. Rathore *et al.* (2025) also showed in their comprehensive review that anxiety and depression affect gastrointestinal function directly through gut-brain axis mechanisms, highlighting processes beyond dietary modulation (25). Moreover, this result is consistent with the Biopsychosocial Model of IBS, suggesting that anxiety, particularly, may induce direct physiological changes, including visceral hypersensitivity and vagus nerve mediated motility alterations. (26).

Diet quality has been found to be associated with mental disorder severity

through different pathways. Participants with adequate nutrient intake reported lower levels of stress, anxiety, and depression while also having less severe gastrointestinal symptoms, demonstrating the protective effect of Food Sufficiency. This result may reflect the contribution of essential nutrients in regulating neurotransmitter pathways and systemic inflammation, both central to maintaining emotional regulation and gut homeostasis. In contrast, increased consumption of low-density foods corresponded with lower stress levels and decreased anxiety and depression symptomatology in our sample. This particular finding diverges from the results of Sparling *et al.* (2025) and Solomou *et al.* (2023) who reported that both the consumption of low nutrient quality foods and food insufficiency are associated with higher levels of stress, anxiety and depressive symptoms (27, 28).

This discrepancy can be explained by the study design and outcome assessment. Prior studies have focused on long-term dietary patterns, whereas this study reflects a short-term emotional regulation through palatable, calorie-dense foods, illustrating the correlation with the "comfort food" phenomenon. According to Gemesi *et al.* (29), most stress-eaters are particularly enjoying low nutrient foods such as cookies, fast-food, chocolate, while almost 70% of them are overeaters.

A comparison by sex revealed that women exhibit a lower Body Mass Index and lower reported willingness to change than men. The significant gender differences in terms of BMI are consistent with the Tack SHS survey across 12 European countries, which reported a 25.7 kg/m² BMI for men compared with 25.0 kg/m² for women (30). Our finding regarding higher

willingness to change among men is in contrast with previous results, which suggests that women are generally more concerned with diet and weight control (31-32). The observed pattern may be explained by the fact that the women in the sample may view their current eating behaviors as adequate by correlating them with a lower BMI. On the other hand, men may be more inclined to acknowledge the need for lifestyle changes associated with elevated BMI values. The result can be determined by several factors: socio-demographic (the young women included in the study are 18-25 years old, which favors a good level of health), medical (the BMI level is comfortable) and socio-cultural (the young women value health, declared that they diet and are concerned about a healthy lifestyle, a fact proven by the researched variables, such as sleep, nutrition, physical activity, lifestyle, etc.) that make them less willing to change because they feel comfortable and satisfied with their body-image.

A key finding of the current study is the strong correlation between irritable bowel syndrome (IBS) and increased psychological burden. Participants with IBS scored significantly higher on the measures of stress, anxiety, and depression. These findings are concordant with the established concept of a "vicious cycle" of functional gastrointestinal disorders. This concept suggests that the unpredictability of symptoms exacerbates psychological distress and perpetuates condition severity (33).

Furthermore, patients with IBS reported lower VAS-IBS scores, reflecting both greater symptom severity and lower perceived quality of life in individuals without a clinical diagnosis. Both the participants with or without IBS stated that they manifested digestive symptoms such as ab-

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dominal pain and bloating during stressful periods, which reinforces the idea of an immediate correlation between stress and intestinal function.

Individuals from our study who reported antibiotic consumption in the last 12 months revealed greater depressive symptoms and more severe gastrointestinal issues than non-users. This result confirms the causal link between antibiotic use and adverse mental health outcomes. These findings support the microbiota-gut-brain axis hypothesis, suggesting that antibiotic-induced alterations in the gut microbiome can disrupt neurochemical signaling between the gut and brain (34). Consistent with our results, this group also showed a higher willingness to change their dietary habits, possibly reflecting a response to the symptoms associated with post-antibiotic dysbiosis.

While our research individualizes a negative relationship between mental health and antibiotic use, a study by Dinan and Dinan (35) presents a nuanced perspective on these effects. They highlighted that certain antibiotics may have antidepressant effects by modulating neuroinflammation, microglial activity, and monoamine levels, whereas other antibiotics can negatively influence mental health by reducing microbial diversity, compromising intestinal barrier integrity, and promoting inflammation. This discrepancy can be attributed to differences in antibiotic type, dosage, and context of administration, as our sample primarily included participants using antibiotics for common short-term infections, whereas the positive antidepressant effects described in their review were associated with specific antibiotics administered in controlled clinical or experimental contexts.

Sleep is an important modulator of the gut-brain axis, and our study revealed a negative correlation between sleep duration and depression, confirming prior research on sleep deprivation and mood dysregulation. Sleep disturbances may disrupt the hypothalamic-pituitary-adrenal axis, resulting in a higher stress level, increased intestinal permeability, and intestinal dysbiosis, all leading to higher susceptibility to depressive symptoms (36).

The positive correlation between Low Nutrient Density Foods and longer sleep hours is a paradoxical finding from our study that can be explained by the lifestyle patterns of young adults. Participants might be sleeping more hours in total, but the irregularity of the sleep pattern might contribute to poorer nutritional choices through a specific craving for high-sugar, high-fat foods to provide a quick energy boost, implying that a disrupted circadian rhythm can influence the brain and conduct to an increased activation in reward centres. Our results are congruent with those in the scientific literature, which generally highlights a complex bidirectional relationship (37-38). Moreover, a vast majority of the participants stated that their sleep affected their digestion, which may reflect interconnected effects involving sleep, gastrointestinal function, mental health, and dietary habits.

Another indispensable lifestyle factor, physical activity was associated with lower anxiety levels and gastrointestinal symptoms. This can be explained by both the enhancement of vagal tone, reducing the level of stress and the release of anti-inflammatory cytokines during activity, decreasing systemic inflammation associated with anxiety and IBS (39). This observation was further supported by the finding

that participants diagnosed with IBS had significantly lower levels of physical activity. Sedentarily deprives IBS patients of stress-relieving and motility-regulating benefits, creating a detrimental cycle and aggravating their condition.

Strengths and limitations of the study.

This is one of the few studies that conducted an integrative analysis of the synergistic effects of lifestyle factors in relation to the gut-brain axis in a young Romanian adult population. Certain limitations of this study need to be acknowledged. First, the sample consisted predominantly of young women and the results were not fully generalizable to the male population or to other age groups. Second, this research has a cross-sectional design, which prevents the establishment of a causal relationship between the factors and the somatic response. Additionally, reliance on self-reporting can lead to overestimated or underestimated correlation, recall bias and social desirability bias. Another limitation is the unmeasured confounders, such as genetic predisposition, early childhood trauma, or the specificity of the antibiotics used by the participants. Furthermore, the REAP v.2 scale and its subscales had a low internal consistency

in this study, with Cronbach's alpha ranging from 0.48 to 0.66.

This could be attributed to the relatively modest sample size (N = 152) or nuanced dietary patterns in this demographic group. For a more comprehensive understanding, future studies should extend this research to clinical populations and investigate whether the observed mediation effects persist over time.

CONCLUSIONS

This study points the importance of healthy eating habits and behaviors in the young population. Stress management, depression anxiety and the adoption of a healthy diet were highlighted as important at this age. These results reflect the importance of educating young people about healthy practices and highlight the impact of psychological balance on physical health.

CONFLICT OF INTEREST AND FUNDING

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