ORIGINAL RESEARCH

# The Effect of Preoperative Anxiety State on Postoperative Intestinal Microecology and Gastrointestinal Function Recovery in Colorectal Cancer Patients

Jie Xu, MM; Mengjiao Li, MM


## ABSTRACT

**Objective** • To investigate the effect of preoperative anxiety status on postoperative intestinal microbiota and gastrointestinal function recovery in colorectal cancer patients with the aim of understanding the potential impact of psychological factors on surgical outcomes and improving patient care.

**Method** • A total of 72 patients who underwent radical resection of colorectal cancer in our hospital from January 2017 to May 2020 were selected. According to the results of Hamilton Anxiety Scale (HAMA) on the day before surgery, the patients were divided into non-anxiety group (HAMA < 7 points) and an anxiety group (HAMA ≥ 7 points). The relationship between preoperative anxiety status and postoperative intestinal microecology and gastrointestinal function recovery in patients with colorectal cancer was analyzed.

**Results** • The first exhaust time and the first defecation time in the non-anxiety group were shorter than those in the anxiety group ($P < .05$). The first complete eating time and postoperative hospitalization time of patients in the non-anxiety group were shorter than those in the anxiety group, and the total incidence of postoperative complications in the anxiety group was higher than that in the non-anxiety group ($P < .05$). There was no significant difference in the number of intestinal flora between the two groups before the operation ($P > .05$). The number of intestinal Lactobacillus and Bifidobacterium in the non-anxiety group was higher than that in the anxiety group at the first defecation and the 15th day after operation. The number of Escherichia coli and cocci was less than that of the anxiety group ($P < .05$). There was no significant difference in preoperative fecal sIgA levels between the two groups ($P > .05$). The level of fecal sIgA in the non-anxiety group was higher than that in the anxiety group at the first defecation and the 15th day after operation ($P < .05$). There was no significant difference in preoperative serum D-lactic acid between the two groups ($P > .05$). The serum D-lactic acid level and urinary L / M ratio in the non-anxiety group were lower than those in the anxiety group at the first defecation and the 15th day after operation ($P < .05$).

**Conclusion** • Our study indicates that preoperative anxiety is associated with postoperative intestinal microbiota imbalance and delayed recovery of gastrointestinal function in colorectal cancer patients. These findings underscore the importance of addressing psychological factors in the care of these patients and suggest that interventions targeting anxiety may improve surgical outcomes and enhance patient recovery. Further research is needed to explore the mechanisms underlying these associations and to develop effective interventions to mitigate the negative impact of preoperative anxiety on postoperative recovery. (*Altern Ther Health Med.* 2024;30(7):240-245).


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## INTRODUCTION

Colorectal cancer is a common malignant tumor of the digestive tract, and surgery is currently the most effective treatment method.[1] Colorectal cancer is a common malignancy of the digestive tract and ranks third in terms of incidence rate worldwide, with approximately 1.8 million new cases and 900 000 deaths annually according to global cancer statistics published in 2020 by the International Agency for Research on Cancer (IARC). In China, colorectal cancer is also among the top five cancers in terms of both incidence and mortality, with the incidence rate increasing rapidly in recent years due to changes in lifestyle, dietary habits, and the aging population. Colorectal cancer patients require preoperative intestinal preparation and severe trauma to the intestine during surgery, which can lead to inflammatory reactions and dysbiosis of the gut microbiota, leading to intestinal endotoxemia, translocation of gut microbiota and bacteria, increasing the incidence of infection complications, affecting prognosis and recovery, and causing serious physical and mental trauma to patients.[2,3] Firstly, dysbiosis increases the risk of infection complications. Imbalanced intestinal microbiota can disrupt the protective barrier function of the gut, making patients more susceptible to postoperative infections such as surgical site infections and anastomotic leaks. These complications can lead to prolonged hospital stays, additional medical interventions, and increased morbidity. Secondly, dysbiosis may negatively affect the prognosis of colorectal cancer patients. The composition and diversity of the intestinal microbiota have been linked to immune system regulation and tumor progression. Imbalances in the microbiota could potentially influence the response to cancer treatment, disease recurrence, and overall survival rates. Lastly, dysbiosis can impede the recovery of gastrointestinal function following surgery. A disrupted microbiota can impair proper digestion and absorption of nutrients, leading to symptoms like diarrhea, constipation, and malnutrition. Slower recovery of gastrointestinal function may prolong the time to oral intake, delay discharge from the hospital, and hinder the overall recuperation process. By highlighting these specific consequences, our study emphasizes the importance of addressing preoperative anxiety and promoting a healthy intestinal microbiota to optimize surgical outcomes, reduce infection risks, improve prognosis, and enhance the recovery of colorectal cancer patients.

Therefore, timely correction of intestinal microbiota imbalance during the perioperative period of colorectal cancer is particularly important. One crucial aspect that can influence surgical outcomes and patient recovery is the psychological state of individuals prior to surgery. Preoperative anxiety, a common occurrence in cancer patients, has been shown to have detrimental effects on various aspects of health, including immune function, wound healing, and overall surgical recovery. Anxiety is a manifestation of adverse psychological and mental states. While stimulating the body and increasing stress response, it can also trigger neurocognitively symptoms, causing patients to experience decreased sleep quality, nervousness, accelerated heart rhythm, and decreased daytime function.[4] Excessive preoperative anxiety can indirectly promote the enhancement of abdominal visceral and skin peripheral blood vessels, cardiac contractions, hypermetabolism, and increased muscle work ability due to fatigue, leading to an increase in postoperative hospitalization time and medical expenses, further increasing the physical and mental stress of patients.[5] Meanwhile, anxiety can also lead to decreased appetite in patients, resulting in reduced intake of vitamins, proteins, lipids, and trace elements, which is insufficient to meet the needs of tumor consumption and tissue cell damage repair.[6]

The purpose of this study is to investigate the impact of preoperative anxiety on postoperative intestinal microbiota and gastrointestinal function recovery in colorectal cancer patients. Specifically, we aim to explore the relationship between preoperative anxiety and dysbiosis in the intestinal microbiota, as well as the subsequent effects on postoperative gastrointestinal function recovery. Colorectal cancer is a multifaceted disease that can have significant impacts on the structure and function of the intestine, as well as the overall well-being of patients. While surgical management is a critical aspect of treatment, psychological factors such as preoperative anxiety can also play a crucial role in patient outcomes. To address this knowledge gap, our study examines the specific link between preoperative anxiety and intestinal microbiota dysbiosis, which can have detrimental effects on immune function, wound healing, and overall surgical recovery. Furthermore, we investigate the impact of dysbiosis on postoperative gastrointestinal function recovery, including the time to first bowel movement, the incidence of postoperative complications, and the length of hospital stay. By exploring these specific aspects, our study aims to provide valuable insights into the potential impact of psychological factors on surgical outcomes and patient care. Ultimately, we hope that our findings will contribute to the development of effective interventions to optimize surgical outcomes, reduce infection risks, improve prognosis, and enhance the recovery of colorectal cancer patients..

## MATERIALS AND METHODS

**General data.** A total of 72 patients who underwent radical resection of colorectal cancer in our hospital from January 2017 to May 2020 were selected. Inclusion criteria: (1) Preoperative diagnosis of colorectal cancer through abdominal CT enhancement and colonoscopy; (2) Indications for radical surgery and complete preoperative examination; (3) No important organ failure, no liver and kidney dysfunction. Exclusion criteria: (1) Patients with acute intestinal obstruction, intestinal bleeding, perforation, and other complications, as well as patients with extensive infiltration and metastasis of tumors during operation who could not undergo radical resection; (2) Patients with chronic inflammatory infectious diseases, chronic diarrhea and functional gastrointestinal diseases; (3) Patients with cognitive dysfunction and mental disorders; (4) Patients with long-term or extensive use of glucocorticoids before surgical treatment or the need for glucocorticoids due to certain diseases; (5) The patient has received radiotherapy and chemotherapy before surgery. All participants were informed and signed an informed consent form for this study, which was approved by the Medical Ethics Committee of our hospital. By clearly defining the inclusion and exclusion criteria, we ensure that the selected patient population is representative of the specific research question and minimizes potential confounding factors, thus enhancing the internal validity of our study. Ethical considerations were also taken into account, as all participants provided informed consent, and the study protocol was approved by the Medical Ethics Committee of our hospital.

## Method

**Determination of preoperative anxiety state.** All patients were given thoracoscopic radical resection of lung cancer according to the examination results after admission. The patients were given intravenous inhalation combined with general anesthesia. All patients were given adjuvant radiotherapy and chemotherapy before the operation, and intravenous pump analgesia was given on the second day after the operation. The Hamilton Anxiety Scale (HAMA)[7] was evaluated the day before the operation, including 14 items, each item was 0-4 points, and the total score was 28 points for severe anxiety. Patients with HAMA < 7 points were divided into a non-anxiety group, and patients with HAMA ≥ 7 points were divided into anxiety group.

**Evaluation Indicator.** (1) Recovery of gastrointestinal motility: The time of first exhaust and defecation after operation (ti.e., the time from the end of operation to the first recovery of spontaneous exhaust and defecation) was recorded in the two groups. (2) Postoperative recovery and complications of patients: The first time of getting out of bed, the time of complete diet, the time of postoperative hospitalization, postoperative infection (including abdominal infection, urinary tract infection, pulmonary infection), intestinal obstruction and anastomotic leakage were recorded in the two groups.

(3) Determination of intestinal flora: The stool samples of the first defecation after the operation and the fifteenth day after the operation were tested. The fresh middle feces of the patients were collected and stored in the sterile kit, and the samples were sent to the laboratory of our hospital for inspection in time. A total of 0.5 g fecal samples were diluted and inoculated in different selective media, and cultured in an incubator at 35°C according to the cultivation methods of aerobic bacteria and anaerobic bacteria. After the culture was completed, the number of bacteria was identified according to the plate viable count method, the CFU value was calculated and expressed as 1 g CFU/g, and the B/E value was calculated. (4) Detection of fecal sIgA level: The immune reagent method was used for detection. After taking the method of 1.2.2, the feces were collected and stored, and 4.5 mL of normal saline was added. The oscillator was shaken for 5 min to fully dissolve the shock to fully dissolve the components in the feces and stored at 4°C. The centrifuge was used to centrifuge the samples at 4000 r/min for 5 min, and the supernatant was taken to determine the sIgA level. The sIgA immunoassay kit was purchased from Shanghai Radioimmunoassay Technology Co., Ltd. (Shanghai, China). (5) Detection of serum D-lactic acid and urine L/M ratio: D-lactic acid and urine L / M are important indicators of peritoneal permeability. Three days before surgery, the first day after surgery, and the fifteenth day after surgery, the peripheral venous blood of the patients was collected and the plasma D-lactic acid was determined by modified spectrophotometry. After the protein was precipitated by perchloric acid, the sample was made into a deproteinized neutralization solution and stored in a refrigerator at-20°C. The buffer containing NAD + (reducing coenzyme 1) at pH 9.5 was prepared before detection, and 2.5 mg/mL NAD + was added at a volume ratio of 1 : 3. The standard tube and the test tube were added with 600 U/L D-LDH 50 μL, and 50 μL distilled water was added to the blank tube. After standing for 90 min, the absorbance was read at 340 nm. The standard curve range of D-lactic acid was 0 ~ 20 mg/L. D-lactate standard and D-lactate dehydrogenase (D-LDL) were purchased from Sigma. At the same time, the morning urine of the patients was collected to detect the urine L / M ratio by high-performance liquid chromatography.

**Table 1.** Comparison of HAMA score and general data

| Clinical Data | n | Anxiety Group (n = 23) | Non-anxiety Group (n = 49) | $\chi^2$ | *P* value |
|---|---|---|---|---|---|
| Age | | | | | |
| <60 years | 48 | 15 | 33 | 0.032 | .858 |
| ≥60years | 24 | 8 | 16 | | |
| Gender | | | | | |
| Male | 45 | 17 | 28 | 1.878 | .171 |
| Female | 27 | 6 | 21 | | |
| Dukes Grade | | | | | |
| Stage A | 29 | 10 | 19 | 0.725 | .696 |
| Stage B | 26 | 9 | 17 | | |
| Stage C | 17 | 4 | 13 | | |
| Tumor Location | | | | | |
| Colon | 47 | 17 | 30 | 1.112 | .292 |
| Rectum | 25 | 6 | 19 | | |

**Table 2.** Comparison of postoperative gastrointestinal motility recovery time between the two groups of patients

| Item | Anxiety Group (n = 23) | Non-anxiety Group (n = 49) | *t* | *P* value |
|---|---|---|---|---|
| First Exhaust Time (h) | 56.41±23.43 | 45.13±19.64 | 2.135 | .036 |
| First Defecation Time (h) | 69.15±30.15 | 55.47±21.12 | 2.225 | .029 |

## Statistical Analysis

Statistic Package for Social Science (SPSS) 21.0 (IBM, Armonk, NY, USA) was used to analyze the experimental data. The measurement data conforming to the normal distribution were expressed by $\bar{x} \pm s$, and the two groups were compared by independent sample ***t*** test. The enumeration data were expressed as the number of cases or rates. The $\chi^2$ test was used for comparison between the two groups, and the Kruskal Wallis rank sum test was used for comparison of multi-group classification data. $P < .05$ was considered statistically significant.

# RESULTS

## Comparison of HAMA score and general data

There was no statistically significant difference in gender, age, Dukes stage, and tumor location between the two groups ($P > .05$), as shown in Table 1.

## Comparison of postoperative gastrointestinal motility recovery time between the two groups of patients

The first exhaust time and the first defecation time in the non-anxiety group were shorter than those in the anxiety group ($P < .05$), as shown in Table 2.

## Postoperative recovery and complications of the two groups of patients

The first eating full diet time and postoperative hospital stay in the non-anxiety group were shorter than those in the

**Table 3.** Postoperative recovery and complications of the two groups of patients

| Item | Anxiety Group (n = 23) | Non-anxiety Group (n = 49) | *t* | *P* value |
|---|---|---|---|---|
| Eating full diet time (d) | 11.43±2.54 | 9.76±0.62 | 4.365 | .000 |
| Postoperative Hospitalization time (d) | 14.87±3.76 | 11.21±2.66 | 4.750 | .000 |

**Table 4.** Comparison of postoperative complications between the two groups of patients

| Item | Anxiety Group (n = 23) | Non-anxiety Group (n = 49) | $\chi^2$ | *P* value |
|---|---|---|---|---|
| Postoperative infection | | | | |
| Pulmonary infection | 1 | 0 | | |
| Urinary tract infection | 2 | 1 | | |
| Abdominal infection | 1 | 2 | | |
| Ileus | 1 | 1 | | |
| Anastomotic leakage | 2 | 1 | | |
| Total incidence (%) | 7 (30.43) | 5 (10.20) | 4.613 | .032 |

**Table 5.** Changes of intestinal flora in two groups of patients (1g CFU/g)

| Item | Anxiety Group (n = 23) | Non-anxiety Group (n = 49) | *t* | *P* value |
|---|---|---|---|---|
| Escherichia coli | | | | |
| Preoperation | 7.71±0.43 | 7.84±0.26 | 1.591 | .116 |
| First postoperative bowel movement | 9.43±0.57 | 8.17±0.58 | 8.641 | .000 |
| Fifteenth postoperative bowel movement | 9.13±0.37 | 7.28±0.39 | 19.069 | .000 |
| Coccobacillus | | | | |
| Preoperation | 7.28±0.27 | 7.23±0.31 | 0.664 | .509 |
| First postoperative bowel movement | 8.89±0.26 | 8.21±0.28 | 9.823 | .000 |
| Fifteenth postoperative bowel movement | 8.16±0.47 | 7.63±0.56 | 3.931 | .000 |
| Bifidobacterium dentium | | | | |
| Preoperation | 7.58±0.52 | 7.43±0.51 | 1.156 | .251 |
| First postoperative bowel movement | 6.12±0.23 | 7.16±0.24 | 17.368 | .000 |
| Fifteenth postoperative bowel movement | 7.76±0.27 | 9.65±0.43 | 19.326 | .000 |
| Lactobacillus | | | | |
| Preoperation | 7.54±0.44 | 7.51±0.46 | 0.262 | .794 |
| First postoperative bowel movement | 6.79±0.24 | 7.21±0.36 | 5.081 | .000 |
| Fifteenth postoperative bowel movement | 8.22±0.47 | 9.54±0.57 | 9.661 | .000 |
| B / E value | | | | |
| Preoperation | 0.75±0.13 | 0.73±0.23 | 0.388 | .699 |
| First postoperative bowel movement | 0.06±0.02 | 0.16±0.06 | 7.768 | .000 |
| Fifteenth postoperative bowel movement | 0.37±0.16 | 0.65±0.31 | 4.074 | .000 |

**Table 6.** Fecal sIgA levels in two groups of patients (mg/g)

| Item | Anxiety Group (n = 23) | Non-anxiety Group (n = 49) | *t* | *P* value |
|---|---|---|---|---|
| Preoperation | 1.14±0.23 | 1.16±0.14 | 0.456 | .650 |
| First postoperative bowel movement | 0.61±0.04 | 0.67±0.05 | 5.041 | .000 |
| Fifteenth postoperative bowel movement | 1.05±0.11 | 1.26±0.15 | 5.991 | .000 |

**Table 7.** Comparison of serum D-lactic acid and urinary L / M levels between the two groups of patients (μg/mL)

| Item | Anxiety Group (n = 23) | Non-anxiety Group (n = 49) | *t* | *P* value |
|---|---|---|---|---|
| D-lactic acid | | | | |
| Preoperation | 0.63±0.29 | 0.65±0.32 | 0.255 | .800 |
| First postoperative bowel movement | 10.36±0.26 | 9.54±0.24 | 13.163 | .000 |
| Fifteenth postoperative bowel movement | 5.05±0.81 | 0.67±0.55 | 26.944 | .000 |
| Urinary L / M ratio | | | | |
| Preoperation | 2.45±0.43 | 2.48±0.14 | 0.444 | .659 |
| First postoperative bowel movement | 6.62±1.74 | 5.61±1.58 | 2.449 | .017 |
| Fifteenth postoperative bowel movement | 3.28±0.25 | 2.69±0.59 | 4.549 | .000 |

anxiety group, and the total incidence of postoperative complications in the anxiety group was higher than that in the non-anxiety group ($P < .05$), as shown in Table 3 and Table 4.

### Changes of intestinal flora in two groups of patients

There was no statistically significant difference in the number of intestinal flora between the two groups before operation ($P > .05$). The number of intestinal Lactobacillus and Bifidobacterium in the non-anxiety group was higher than that in the anxiety group at the first defecation and the fifteenth day after operation. The number of Escherichia coli and cocci was less than that of the anxiety group ($P < .05$), as shown in Table 5.

### Fecal sIgA levels in two groups of patients

There was no statistically significant difference in preoperative fecal sIgA levels between the two groups ($P > .05$). The level of fecal sIgA in the non-anxiety group was higher than that in the anxiety group at the first defecation and the 15th day after operation ($P < .05$), as shown in Table 6.

### Detection of intestinal barrier function in two groups of patients

There was no statistically significant difference in serum D-lactic acid between the two groups before the operation ($P > .05$). The serum D-lactic acid level and urinary L / M ratio in the non-anxiety group were lower than those in the anxiety group at the first defecation and the 15th days after the operation ($P < .05$), as shown in Table 7.

## DISCUSSION

In patients with colorectal cancer, preoperative oral intestinal antibiotics and laxatives, intraoperative trauma and anesthesia, postoperative fasting, no drinking, and preventive use of antibiotics can change the microenvironment of postoperative intestinal flora, and intestinal probiotics are replaced by pathogenic bacteria. Gradually lose its dominant position, and the proliferation of pathogenic bacteria destroys the intestinal flora barrier composed of Bifidobacterium, Enterobacter, and Enterococcus, inducing a large number of intestinal flora, endotoxin, and bacterial translocation, resulting in intestinal infection and endotoxemia.[8,9] Therefore, correcting the imbalance of intestinal flora can promote the recovery of gastrointestinal function in patients with colorectal cancer after surgery and accelerate their early recovery.

The unity of the interaction and influence between intestinal flora and the human body is called gut microecology, which is the largest microecosystem of the human body and is closely related to human health and disease.[10] In the past decade, a large number of studies and evidence have shown that intestinal microecology can regulate brain function.[11] With the proposal and confirmation of the ‘ brain-gut-microbiota ‘ axis theory, studies on microecology have involved central nervous system diseases, including depression-related behaviors.[12] Preoperative anxiety may lead to intestinal microecological imbalance by directly or indirectly affecting intestinal neuroendocrine regulation, immune function, and intestinal flora composition, thus affecting the recovery of gastrointestinal motility and digestive function, and prolonging the recovery period and hospitalization time of patients.[13,14] In addition, some studies have found that higher preoperative anxiety symptoms are positively correlated with the incidence and severity of postoperative complications.[15] The results of this study showed that the number of intestinal Lactobacillus and Bifidobacterium in the non-anxiety group was higher than that in the anxiety group at the first defecation and the fifteenth day after operation. The number of Escherichia coli and coccidia in the preoperative anxiety group was less than that in the anxiety group, indicating that preoperative anxiety can aggravate the intestinal microecological imbalance and reduce the number of Lactobacillus and Bifidobacterium in the intestinal tract of patients with colorectal cancer after operation. This study found that the first exhaust time and the first defecation time of patients in the non-anxiety group were shorter than those in the anxiety group; the first complete eating time and postoperative hospital stay in the non-anxiety group were shorter than those in the anxiety group. The total incidence of postoperative complications in the anxiety group was higher than that in the non-anxiety group, which was consistent with previous studies.[16] It indicates that preoperative anxiety may be related to the greater damage to the patient's intestinal tract and its surrounding tissues during laparoscopic surgery. Preoperative anxiety can lead to slow recovery of patients in the early postoperative period. This study found that the level of fecal sIgA in the non-anxiety group was higher than that in the anxiety group at the first defecation after the operation and on the fifteenth day after the operation. The serum D-lactic acid level and urinary L / M ratio of patients in the non-anxiety group were lower than those in the anxiety group at the first defecation and the fifteenth day after the operation, indicating that the preoperative anxiety state would affect the postoperative intestinal microecological environment of patients with colorectal cancer and reduce the intestinal barrier function. Anxiety may lead to a disorder of the neuroendocrine system, which leads to the imbalance of intestinal microecology, reduces the function of the gastrointestinal tract, and then affects the clearance of defecation and metabolites.

Preoperative anxiety is known to affect the neuroendocrine system, resulting in an elevation of stress hormones such as cortisol and catecholamines. The release of these hormones can have significant effects on intestinal function, including an increase in intestinal permeability and alteration of gut motility. These changes, in turn, can lead to dysbiosis or an imbalance in the gut microbiome. Dysbiosis may result from several factors, including increased intestinal permeability, changes in the host immune system, and shifts in microbial populations. Intestinal barrier dysfunction induced by stress hormones can facilitate the translocation of microorganisms and their toxins from the gut lumen into the bloodstream, leading to systemic inflammation and immune activation. These changes can contribute to alterations in the gut ecosystem and compromise its stability and resilience. Furthermore, preoperative anxiety may also directly impact the composition and function of the gut microbiome through the gut-brain axis. The gut microbiome is known to modulate brain function and behavior through the bidirectional communication between the gut and the central nervous system. Stress and anxiety can affect this communication and disrupt the balance of the gut-brain axis, leading to alterations in gut microbiome composition and function. The gut microbiome plays a crucial role in metabolite clearance, nutrient absorption, and energy metabolism. Dysbiosis induced by preoperative anxiety may lead to a reduction in beneficial microbes that produce short-chain fatty acids (SCFAs), critical metabolites that support intestinal homeostasis and immune regulation. SCFAs also play a role in promoting overall health, including cardiovascular health, weight management, and diabetes prevention. In summary, preoperative anxiety can lead to postoperative intestinal microecological imbalance through several mechanisms, including alterations in the gut-brain axis, intestinal permeability, immune system activation, and reduced beneficial microbial populations. Dysbiosis induced by preoperative anxiety may also lead to a reduction in essential metabolites critical for intestinal homeostasis and overall health. Further research into these mechanisms can inform the development of targeted interventions aimed at mitigating the negative effects of preoperative anxiety on postoperative outcomes.

Investigating the relationship between preoperative anxiety and postoperative intestinal microecology is crucial for the rehabilitation of colorectal cancer patients. Psychological factors can influence the composition and function of the gut microbiota, affecting gastrointestinal homeostasis and immune regulation. Understanding these mechanisms can lead to targeted interventions to mitigate the negative effects of anxiety on postoperative outcomes. Personalized interventions, such as cognitive-behavioral therapy, can improve the gut microenvironment and promote better recovery. Optimizing postoperative care considering the interplay between psychological and physiological aspects enhances patient outcomes and the rehabilitation experience. Further research in this area has the potential to improve colorectal cancer surgery outcomes.

One limitation of our study is the relatively small sample size, which may limit the generalizability of our findings. Additionally, as a retrospective study, we did not have access to data on certain confounding factors that could impact gut microbiota composition and function, such as dietary habits, medication use, and comorbidities. Another potential limitation is the use of self-reported anxiety measures, which may be subject to personal biases or recall errors. In future studies, objective measures of anxiety, such as cortisol levels or heart rate variability, can provide more precise assessments of psychological stress. To address these limitations and further explore the mechanisms of preoperative anxiety's impact on intestinal microecology and gastrointestinal function recovery, future studies could consider larger sample sizes and standardized assessments of relevant confounding variables. Additionally, longitudinal studies that track changes in the gut microbiota and immune function before and after surgery would provide more insight into the causal relationships between preoperative anxiety and postoperative outcomes. Finally, randomized controlled trials that evaluate the efficacy of psychological interventions, such as cognitive-behavioral therapy or mindfulness-based stress reduction, in mitigating the negative effects of preoperative anxiety on postoperative outcomes would be valuable for developing targeted interventions.

The findings suggest that preoperative anxiety can have a significant impact on postoperative outcomes, including dysbiosis and delayed recovery. Therefore, interventions aimed at reducing preoperative anxiety may be beneficial for improving patient outcomes. Psychological support, such as cognitive-behavioral therapy or relaxation techniques, can help reduce anxiety levels and improve postoperative recovery. Additionally, dietary modifications, such as probiotic supplementation or a high-fiber diet, may help mitigate the negative effects of dysbiosis on gut health and immune function. Healthcare providers should consider incorporating these interventions into preoperative care plans to optimize patient outcomes and reduce the risk of postoperative complications.

In conclusion, emphasizing the significance of reducing preoperative anxiety levels and proposing preventive measures such as psychological interventions and support measures can greatly enhance the postoperative recovery of patients. Psychological interventions, including cognitive-behavioral therapy and relaxation techniques, should be implemented to alleviate anxiety and improve overall well-being. Additionally, comprehensive support measures such as patient education, counseling, and social support should be provided to help patients cope with preoperative anxiety and facilitate a more successful postoperative rehabilitation. By addressing preoperative anxiety and implementing preventive strategies, healthcare professionals can optimize patient outcomes and promote a smoother recovery process.

## CONFLICT OF INTEREST

The authors have no potential conflicts of interest to report relevant to this article.

## AUTHOR CONTRIBUTIONS

JX and ML designed the study and performed the experiments, JX collected the data, ML analyzed the data, and JX and ML prepared the manuscript. All authors read and approved the final manuscript.

## FUNDING

This study did not receive any funding in any form.

## ETHICAL COMPLIANCE

This study was approved by the ethics committee of West China School of Public Health and West China Fourth Hospital. Signed written informed consent were obtained from the patients and/or guardians.

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