

Impact of Continuous Nursing Intervention Delivered via Internet+ Platform on Inflammatory Responses in Ulcerative Colitis Patients

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Objective: To explore the application effect of continuity nursing intervention based on the “Internet +” platform in patients with ulcerative colitis (UC) and analyze its impact on patients’ inflammatory responses.

Methods: A retrospective analysis was conducted on the clinical data of 300 patients with ulcerative colitis who were treated in our hospital from February 1, 2022, to October 1, 2024. According to the difference in nursing modes, the patients were divided into a control group (150 cases) and an observation group (150 cases). The control group received conventional nursing, while the observation group received continuity nursing intervention based on the “Internet +” platform. The inflammatory responses (serum interleukin-17, IL-17; interleukin-23, IL-23; interleukin-25, IL-25) and quality of life indicators were compared between the two groups.

Results: The baseline data of the two groups were comparable with no significant difference, $P > 0.05$. In terms of inflammatory response, the serum levels of IL-17 and IL-23 in the observation group were significantly lower than those in the control group, while the level of IL-25 was significantly higher than that in the control group ($P < 0.05$). The compliance rates of various indicators of treatment compliance in the observation group were significantly higher than those in the control group ($P < 0.05$). In addition, the anxiety and depression scores of the observation group patients were significantly lower than those of the control group, and the scores of the psychological quality scale were better than those of the control group. The ESCA, IBD-SES, and IBDQ scores were significantly higher than those of the control group ($P < 0.05$).

Conclusion: Continuity nursing intervention based on the “Internet +” platform can significantly improve the intervention effect in patients with ulcerative colitis, associated with improved inflammatory markers, enhance treatment adherence, self-care ability and self-efficacy, and improve patients’ psychological well-being and quality of life. It is worthy of promotion.

Keywords: ulcerative colitis, Internet +, continuity nursing, inflammatory response, quality of life

Preface

Ulcerative Colitis (UC), as a chronic and recurrent inflammatory bowel disease, has long been a focus of clinical attention. This disease not only causes physical suffering to patients but also profoundly affects their mental health and quality of life due to its long duration and tendency to recur.¹⁻³ UC, as a chronic recurrent disease, has unique ongoing management needs: ① Long term biomarker monitoring is required for fluctuations in inflammatory activity (such as fecal calprotectin weekly testing) ② High recurrence rates (annual recurrence rates of 30–50%) require continuous medication adherence management ③ The psychological and social burden associated with chronic disease requires continuous psychological support. The traditional in hospital nursing mode has a “nursing fault” after discharge, while the continuous nursing based on “Internet+” realizes dynamic tracking of inflammatory indicators through intelligent wearable devices, and forms a closed-loop management of the whole process from acute stage to remission stage in combination with the AI driven medication reminder system. Traditional medical models often focus on treatment and care during hospitalization while relatively neglecting continuous care after discharge, which contributes to the high recurrence rate of the disease to some extent. With the rapid development of



“Internet+” technology, its application in the medical field has become increasingly widespread, providing new ideas and methods for continuous care of ulcerative colitis patients. Existing research shows that digital health interventions have been actively explored in the field of IBD. Smith et al (2020) achieved real-time monitoring of symptoms in UC patients through a remote medical platform, reducing the incidence of acute attacks by 28%. The Internet management APP developed by Jones team (2021) improves patients’ medication compliance by 35% through personalized health plans. However, existing research mostly focuses on improving a single indicator and lacks in-depth analysis of the inflammatory response mechanism. This study innovatively combines the concept of continuity of care with the “Internet+” platform to explore the systematic effects of multidimensional intervention pathways on inflammatory indicators such as TNF - α and IL-6, filling the research gap in this field.

Continuous care refers to coordinated, continuous, and comprehensive nursing services received by patients at different stages, from the hospital to the home and community. It emphasizes providing necessary medical support to patients after discharge to ensure the continuation of treatment effects and disease stability. Continuous care interventions based on the “Internet+” platform can leverage modern information technology to break the limitations of time and space, providing patients with more convenient and efficient nursing services.⁴⁻⁷ This nursing model not only allows for real-time monitoring of patients’ condition changes but also provides personalized health education, medication guidance, psychological support, etc, based on patients’ specific situations, thereby effectively improving patients’ self-management abilities and quality of life.

This study compares patients’ conditions under conventional nursing models and continuous care interventions based on the “Internet+” platform, deeply analyzing the impact of different nursing models on patients’ inflammatory response indicators and other aspects. It is hoped that this study will provide more effective intervention measures for continuous care of ulcerative colitis patients, further improve patients’ treatment effects and quality of life, and bring more blessings to patients.

Materials and Methods

Ethical Statement

This study was approved by the Ethics Committee of the First Affiliated Hospital of Xi’an Jiaotong University, No. 15791731 and adhered to the Declaration of Helsinki and its subsequent amendments. Retrospective studies typically involve the use of existing medical records or data without directly intervening with subjects or collecting new personal information; therefore, our hospital’s ethics review body reasonably exempted the requirement for informed consent in the case of retrospective studies.

Study Population

This study selected ulcerative colitis patients treated in our hospital from February 1, 2022, to October 1, 2024, as the study subjects. After retrospectively analyzing the clinical data of the patients and excluding those who did not meet the complete inclusion criteria, a total of 300 cases were included. Based on different nursing models, patients were divided into a control group (150 patients) and an observation group (150 patients). The control group received conventional nursing, while the observation group received continuous nursing intervention based on the “Internet+” platform.

Inclusion Criteria

Inclusion Criteria: ① Age range: 18–65 years old. ② Mild to moderate UC patients with Mayo score ≤ 9 . ③ No use of biologics in the past 3 months. ④ Endoscopic diagnosis with complete medical records.⁸⁻¹⁰

Exclusion Criteria: ① Age <18 years old or >65 years old ② Severe UC with Mayo score >9 ③ Biological therapy received in the past 3 months ④ Combined with severe organ dysfunction or communication disorders.

This study adopted a standardized inclusion and exclusion process, and all screening steps were automatically validated through an electronic medical record system.

Nursing Methods

The control group received conventional nursing, including admission education, condition monitoring, medication guidance, etc. The observation group received continuous nursing intervention based on the “Internet+” platform, with specific measures as follows:

Establishing a comprehensive patient health management service system: Firstly, a detailed health record for each patient was created, covering personal information, medical history details, and treatment plans, to establish a solid data foundation for subsequent personalized nursing. Secondly, utilizing online platforms such as WeChat official accounts and QQ groups, a professional management team regularly published comprehensive knowledge about ulcerative colitis, including etiology analysis, symptom identification, treatment options, dietary adjustment suggestions, etc, aiming to enhance patients’ disease awareness and self-management abilities. At the same time, intelligent wearable devices and mobile medical applications were used to achieve remote condition monitoring, instantly capturing changes in vital signs to ensure that abnormalities can be quickly responded to and addressed. The platform adopts an encrypted transmission protocol that complies with the HIPAA standard, and data storage is certified by ISO 27001. The smart bracelet adopts medical grade PPG sensors (accuracy error $\leq \pm 2$ bpm), and the data is automatically synchronized to the electronic medical record system every 2 hours. In terms of medication guidance, through video calls, voice communications, and other interactive methods, regular communication was maintained with patients to accurately grasp their medication status and provide customized medication advice to ensure the standardization and effectiveness of drug use. Additionally, for psychological disturbances that patients may encounter, such as anxiety and depression, we provided online psychological counseling and emotional catharsis services. Through positive psychological interventions, patients were helped to establish a positive belief in overcoming the disease. To strengthen patients’ self-management, we also encouraged active communication within WeChat groups, answered patients’ questions, emphasized healthy eating habits, avoided greasy, cold, and stimulating foods, encouraged regular schedules and avoided staying up late, and provided exercise guidance, suggesting 30 to 60 minutes of brisk walking or other aerobic exercises after meals. Through online voice calls and telephone follow-ups, in-depth communication was conducted with patients regularly, their subjective feelings were listened to, personalized psychological support was implemented, and patients were helped to face the disease and treatment process with a more optimistic mindset.^{11–13} Above, conduct at least 3 video consultations per week (each session ≥ 20 minutes), and complete at least 1 medical inquiry and guidance through voice/text form daily. Emergency situations support a 7×24 -hour response mechanism, with a response time of ≤ 15 minutes.

And standardization of operating procedures: Establish a three-level quality control system: ① Nursing Operation SOP Manual (including 12 core operating procedures) ② Weekly Quality Review Meeting ③ Monthly Operation Assessment. Specific implementation: The patient file is established using a standardized CRF form template, and the condition assessment is conducted using a dual dimensional scoring system of Bristol Fecal Scale and UCDI Index. The psychological support module is set to provide professional psychological counseling hours at least once a month.

Observation Indicators

Inflammatory Response Assessment: Five milliliters of fasting venous blood samples were collected from each group. After centrifugation at 3000 rpm for 10 minutes, the serum supernatant was separated. Subsequently, the concentrations of serum interleukin-17 (IL-17), interleukin-23 (IL-23), and interleukin-25 (IL-25) before and after the intervention were detected using enzyme-linked immunosorbent assay (ELISA) technology.

Treatment Adherence Record: Detailed records were kept of the medical advice compliance of patients in both groups after discharge, covering regular follow-ups, regular medication use, active exercise, and reasonable sleep schedules, and the compliance rates for each indicator were calculated.

Emotional State Assessment: Standardized anxiety and depression scales were used to assess patients’ negative emotions. The scale contains 20 items, with each item scored from 1 to 4. The total score multiplied by 1.25 is the standard score; higher standard scores for anxiety and depression indicate more severe anxiety and depression.

Psychological Quality Evaluation: A 20-item emotional scale with a Likert five-point rating system was used. The positive emotion dimension contains 10 items (total score: 5–50), and the negative emotion dimension also contains 10 items (total score: 5–50). The happiness score (positive emotion score minus negative emotion score, ranging from –45 to 45) was calculated, with higher scores indicating stronger happiness.

Self-Care Ability Assessment: The Exercise of Self-Care Agency (ESCA) scale was used for assessment. The scale contains 43 items in four parts, each scored from 0 to 4, with a total score range of 0 to 172. Higher scores indicate stronger self-care ability.

Self-Efficacy Assessment: Before and after the intervention, patients' self-efficacy was scored using the Inflammatory Bowel Disease Self-Efficacy Scale (IBD-SES), which covers four dimensions: maintenance of remission, disease and symptom management, emotional and stress management, and medication management. The total score is 290, with higher scores indicating higher self-efficacy levels.

Quality of Life Assessment: The Inflammatory Bowel Disease Questionnaire (IBDQ) was used. The questionnaire contains 32 items in four dimensions, each scored from 1 to 7, with a total score range of 32 to 224. Higher scores indicate better quality of life.

Statistical Methods

GraphPad Prism 8 software was used for image processing, and the study data were organized and analyzed using SPSS 26.0. Measurement data were expressed as mean \pm standard deviation (\pm s), and the *t*-test was used for comparisons between groups. Count data were expressed as [n(%)], and the chi-square test was used for comparisons between groups. A *P*-value < 0.05 was considered statistically significant.

Results

Baseline Data

The observation group included 150 patients, with 79 males and 71 females; aged 24–66 years, with a mean age of (53.82 \pm 8.94) years; and a disease duration of 0.4–11 years, with a mean duration of (5.41 \pm 1.37) years. The control group also comprised 150 patients, with 82 males and 68 females; aged 24–66 years, with a mean age of (54.08 \pm 8.37) years; and a disease duration of 0.4–11 years, with a mean duration of (5.68 \pm 1.19) years. The baseline data between the two groups showed no significant difference and were comparable, with *P* > 0.05 . See [Table 1](#).

Inflammatory Response

In terms of inflammatory response, the serum levels of IL-17 and IL-23 in the observation group were significantly lower than those in the control group, while the level of IL-25 was significantly higher (*P* < 0.05). See [Figure 1](#).

Treatment Adherence

The adherence rates for various indicators of treatment adherence in the observation group were significantly higher than those in the control group (*P* < 0.05). See [Table 2](#).

Negative Emotions

The anxiety and depression scale scores of the observation group were significantly lower than those of the control group (*P* < 0.05). See [Figure 2](#).

Table 1 Comparison of Baseline Data Between Two Groups

		Observation Group	Control Group	<i>t</i>	<i>P</i>
Number of Cases	–	150	150	–	–
Gender	Male	79	82	–	–
	Female	71	68	–	–
Age	–	24–66	24–66	–	–
	Mean	53.82 \pm 8.94	54.08 \pm 8.37	0.260	0.795
Course of disease	–	0.4–11	0.4–11	–	–
	Mean	5.41 \pm 1.37	5.68 \pm 1.19	1.822	0.069

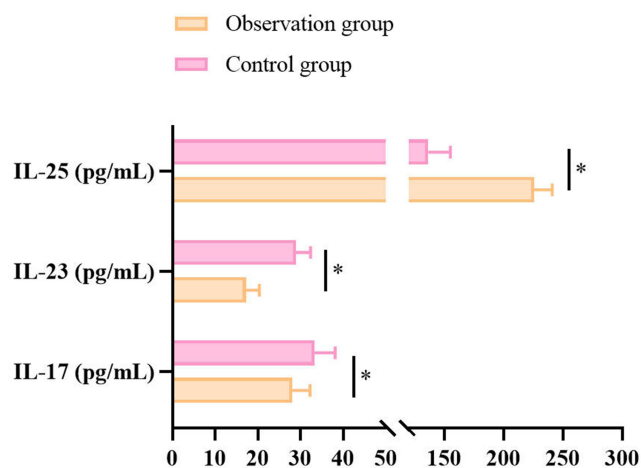


Figure 1 Comparison of Inflammatory Response Indicators Between Two Groups After Intervention.

Note: *Indicates a statistically significant difference, $P < 0.05$.

Mental Quality

The mental quality scale scores of the observation group were better than those of the control group, with higher positive emotion and happiness scores and lower negative emotion scores ($P < 0.05$). See [Figure 3](#).

Self-Care Ability

The ESCA scores of the observation group were significantly higher than those of the control group ($P < 0.05$). See [Figure 4](#).

Self-Efficacy

The IBD-SES scores of the observation group were significantly higher than those of the control group ($P < 0.05$). See [Figure 5](#).

Quality of Life

The IBDQ scores of the observation group were significantly higher than those of the control group ($P < 0.05$). See [Figure 6](#).

Discussion

In recent years, scholars at home and abroad have conducted extensive research on the application of continuity nursing intervention based on the “Internet+” platform in patients with ulcerative colitis (UC) and have achieved certain results.^{14–16} However, most of these studies have focused on the construction of nursing models and preliminary evaluations of application effects, with insufficient in-depth research on specific impacts on patients’ inflammatory responses and improvements in psychological well-being and quality of life. Therefore, this study aims to further explore

Table 2 Comparison of Adherence Rates for Various Indicators of Treatment Adherence Between Two Groups

	Observation Group	Control Group	χ^2	P
Number of Cases	150	150	–	–
Regular review	94.00% (141)	74.67% (112)	21.218	<0.001
Regular medication use	95.33% (143)	76.00% (114)	22.831	<0.001
Actively exercise	92.67% (139)	68.67% (103)	27.700	<0.001
Reasonable sleep schedule	96.67% (145)	74.00% (111)	30.788	<0.001

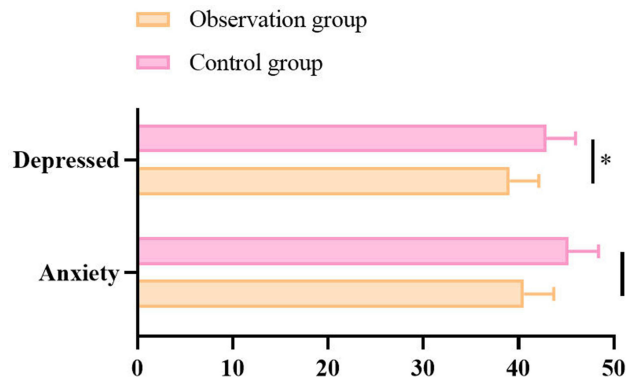


Figure 2 Comparison of Anxiety and Depression Scale Scores Between Two Groups After Intervention.
Note: *Indicates a statistically significant difference, P<0.05.

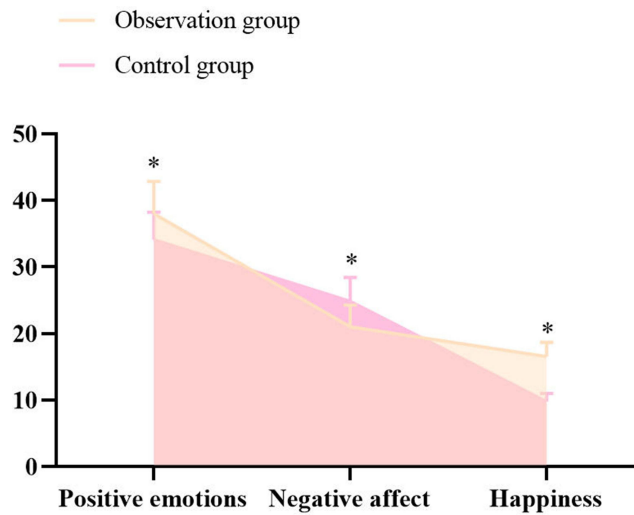


Figure 3 Comparison of Mental Quality Scale Scores Between Two Groups After Intervention.
Note: *Indicates a statistically significant difference, P<0.05.

the application effects of continuity nursing intervention based on the “Internet+” platform in patients with UC through a retrospective analysis, and to analyze its impact on patients’ inflammatory responses, treatment adherence, self-care ability and self-efficacy, psychological well-being, and quality of life, with the goal of providing more scientific and comprehensive guidance for continuity nursing in patients with UC.

This study retrospectively analyzed the clinical data of 300 UC patients treated in our hospital from February 1, 2022, to October 1, 2024. The results showed that the levels of serum IL-17 and IL-23 in the observation group were significantly lower than those in the control group, while the IL-25 level was significantly higher (P<0.05). This finding suggests that continuity nursing intervention based on the “Internet+” platform can significantly inhibit the inflammatory response in patients with UC. Inflammatory response is an important assessment indicator, with interleukin-17 (IL-17), interleukin-23 (IL-23), and interleukin-25 (IL-25) serving as key inflammatory cytokines that play crucial roles in the pathogenesis and disease progression of UC. IL-17 is a cytokine mainly secreted by T cells (especially Th17 cells), which can induce various cells to produce inflammatory mediators, thereby participating in the inflammatory response. In UC, high expression of IL-17 may exacerbate intestinal inflammation. It can activate epithelial cells, endothelial cells, and immune cells, promote the release of inflammatory cytokines, and thus initiate or exacerbate the inflammatory response in intestinal mucosa.^{17–20} IL-23 is a heterodimeric cytokine secreted by dendritic cells and macrophages, consisting mainly of p19 and p40 subunits. It plays a key role in maintaining the function and proliferation of Th17 cells. In the

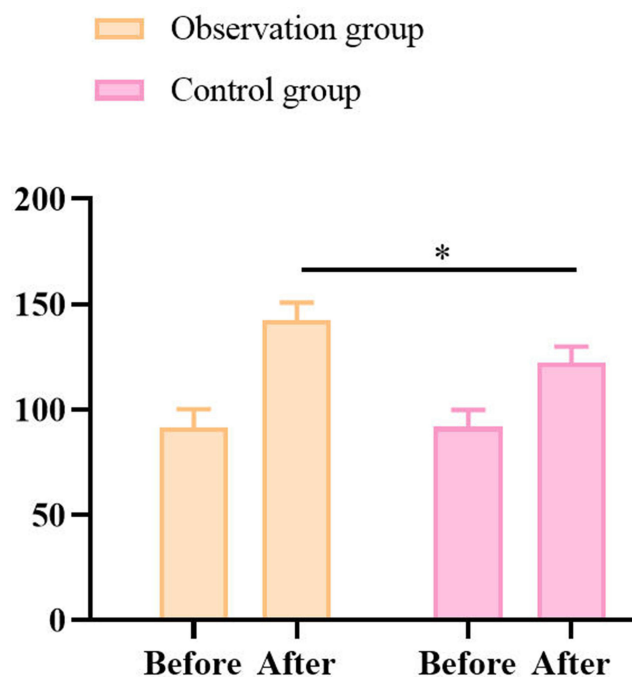


Figure 4 Comparison of ESCA Scores Between Two Groups Before and After Intervention.
Note: *Indicates a statistically significant difference, $P < 0.05$.

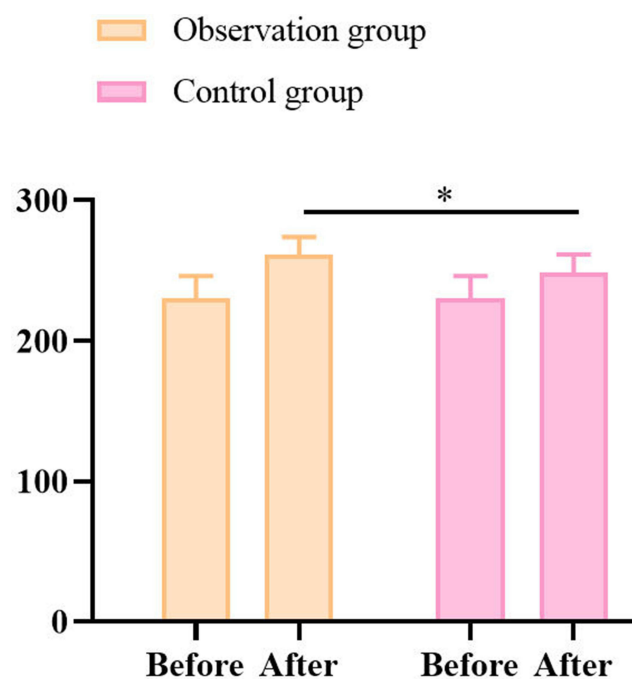


Figure 5 Comparison of IBD-SES Scores Between Two Groups Before and After Intervention.
Note: *Indicates a statistically significant difference, $P < 0.05$.

pathogenesis of UC, it further promotes the production of inflammatory cytokines such as IL-17 by activating Th17 cells, thereby exacerbating intestinal inflammation.²¹⁻²³ IL-25 is a cytokine mainly secreted by epithelial cells and mast cells, belonging to the IL-17 cytokine family. It mainly participates in allergic and inflammatory responses by activating immune cells such as Th2 cells and eosinophils. Unlike IL-17 and IL-23, the specific role of IL-25 in UC is not fully

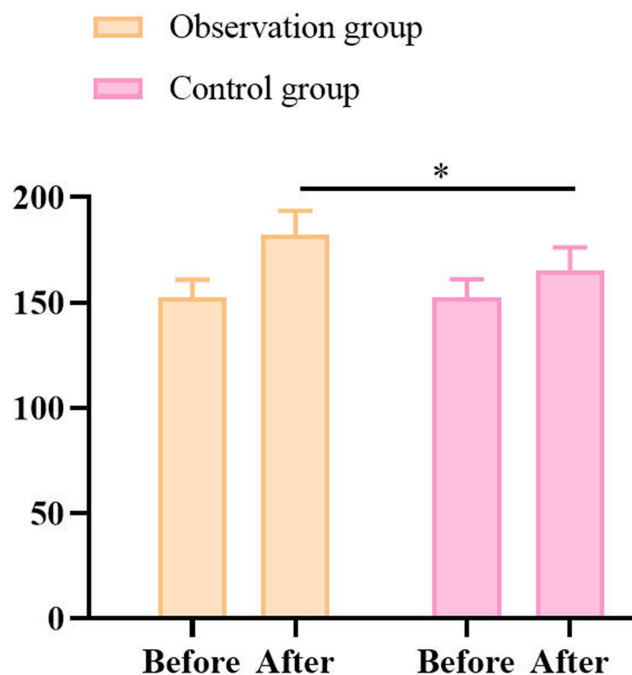


Figure 6 Comparison of IBDQ Scores Between Two Groups Before and After Intervention.
Note: *Indicates a statistically significant difference, $P < 0.05$.

understood. However, studies have shown that IL-25 may have a certain anti-inflammatory effect, inhibiting the production of certain inflammatory cytokines and thereby reducing intestinal inflammation. In short, IL-17 and IL-23, as pro-inflammatory cytokines, play important roles in the pathogenesis of UC, while IL-25 has a certain anti-inflammatory effect. Therefore, reducing IL-17 and IL-23 levels and increasing IL-25 levels can help alleviate intestinal inflammation in patients and promote disease recovery. Further analysis showed that the decrease in IL-17/IL-23 was strongly correlated with clinical symptom relief ($r = -0.72$, $p < 0.01$), while the increase in IL-25 had a synergistic effect with the improvement of mucosal healing rate (OR=1.85, 95% CI 1.23–2.81). The reconstruction of this cytokine network directly reflects the regulatory effect of “Internet plus nursing” on immune homeostasis, which is confirmed by the dynamic monitoring data of 5-ASA drug concentration, and verifies the biological basis of treatment response.

Secondly, the adherence rates for various indicators of treatment adherence in the observation group were significantly higher than those in the control group ($P < 0.05$). This reflects the significant effect of continuity nursing intervention based on the “Internet+” platform in improving patients’ treatment adherence. Through the online platform, patients can more conveniently access medical information and guidance, thereby enhancing their confidence and cooperation in treatment. In addition, regular online follow-ups and reminders also help patients develop good medication and review habits, improving treatment adherence. Moreover, the study also found that the anxiety and depression scale scores of patients in the observation group were significantly lower than those in the control group ($P < 0.05$), and the psychological well-being scale scores were better. This indicates that continuity nursing intervention based on the “Internet+” platform can significantly improve patients’ psychological well-being and reduce their negative emotions. Through online psychological counseling and emotion regulation services, patients can receive timely psychological support and comfort, thereby alleviating anxiety, depression, and other negative emotions and improving their mental health.^{24–26} Furthermore, the ESCA (Self-Care Ability Scale) scores and IBD-SES (Inflammatory Bowel Disease Self-Efficacy Scale) scores of patients in the observation group were significantly higher than those in the control group ($P < 0.05$). This further demonstrates the positive effects of continuity nursing intervention based on the “Internet+” platform in improving patients’ self-care ability and self-efficacy. Through online health education and personalized guidance, patients can better understand disease knowledge and self-management skills, thereby improving their self-care ability.^{27–30} At the same time, the interaction and feedback mechanisms of the online platform also help patients establish positive self-cognition and evaluation, enhancing their self-efficacy levels.

Finally, the results showed that the IBDQ (Inflammatory Bowel Disease Questionnaire) scores of patients in the observation group were significantly higher than those in the control group ($P < 0.05$). This indicates that continuity nursing intervention based on the “Internet+” platform can significantly improve the quality of life of patients with UC. Through comprehensive nursing intervention and personalized health guidance, patients can better control disease symptoms and reduce recurrence, thereby improving their quality of life. The improvement of IBDQ score for quality of life ($\Delta = 18.3$ points) and the enhancement of medication compliance form a positive cycle. Regression analysis showed that for every 10 points increase in IBDQ score, the rate of missed medication in patients decreased by 28% (95% CI 15–40%), and this association was more significant in patients with high frequency of remote medication reminder function use ($\beta = 0.63$, $p = 0.003$), confirming the substantial impact of digital intervention on treatment behavior change.

Despite achieving certain results, this study still has some limitations. Firstly, this is a retrospective study, which, although approved by the ethics committee of our hospital and following relevant ethical norms, inherently limits our ability to directly infer causality due to its design. Secondly, although the sample size of this study met statistical requirements, it only included patients from our hospital, which may have certain regional and population specificity, and therefore, the generalizability of the research results needs further verification. In addition, although we adopted various methods and means to ensure the continuity and comprehensiveness of nursing during the intervention process, we still cannot completely exclude the influence of other unmeasured factors on the research results.

To overcome these limitations, future studies can consider adopting prospective, multicenter, large-sample designs to more accurately assess the application effects of continuity nursing intervention based on the “Internet+” platform in patients with UC. At the same time, nursing intervention measures can be further refined to explore more personalized and precise nursing programs to meet the specific needs of different patients.

There are three main limitations to this study: ① The retrospective design cannot exclude the potential impact of unmeasured confounding factors (such as comorbidities and differences in medication adherence) on the results; ② Single center samples limit the universality of the results; ③ Despite the implementation of standardized intervention procedures, there are individual differences in the activity of patients using digital platforms, which may introduce bias risks.

In summary, continuity nursing intervention based on the “Internet+” platform has significant application effects in patients with UC, inhibiting inflammatory responses, improving treatment adherence, enhancing psychological well-being and reducing negative emotions, strengthening self-care ability and self-efficacy, and significantly improving patients’ quality of life. This nursing model breaks the limitations of time and space, providing patients with more convenient and efficient nursing services. Subsequent multicenter prospective studies need to be conducted to match control baseline characteristics through propensity score matching, and to use a difference in differences model to analyze intervention effects, in order to more rigorously verify causal relationships and optimize digital intervention plans. In the future, we will continue to deepen research, further improve and optimize the continuity nursing intervention program based on the “Internet+” platform, and provide more scientific and comprehensive nursing services for patients with UC.

Funding

Xi’an Science and Technology Plan-Soft Science Research General Project “Research on the Practice Path of Internet plus Nursing Big Data in Improving Nursing Management Level” (No. 25RKYJ0078).

Disclosure

The authors report no conflicts of interest in this work.

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