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Original Article

Risk factors for readmission in hospitalized patients with inflammatory bowel disease: a retrospective cohort study

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Abstract: Background: Inflammatory bowel disease (IBD) is a chronic inflammatory disorder of the gastrointestinal tract characterized by complex clinical manifestations and a high rate of hospital readmission, imposing a substantial burden on patients and healthcare systems. Clarifying the clinical characteristics of IBD patients and identifying risk factors for readmission are crucial for optimizing clinical management strategies. Objective: To analyze the clinical characteristics of hospitalized IBD patients and identify independent risk factors associated with readmission. Methods: This single-center retrospective study included 120 IBD patients admitted to the Department of Gastroenterology at Beijing Friendship Hospital, Capital Medical University, between January 2019 and January 2023. Demographic data, clinical symptoms, laboratory parameters, endoscopic and imaging findings, treatment regimens, and follow-up outcomes (6-12 months) of each patient were collected. Univariate analyses were performed to screen potential factors associated with readmission, followed by multivariate logistic regression to identify independent predictors. Results: The mean age of the included patients was 42.5±12.3 years, with 56.7% being male. Abdominal pain (85.0%) and diarrhea (81.7%) were the most prevalent symptoms. Among the cohort, 51 patients (42.5%) were diagnosed with Crohn's disease (CD) and 69 (57.5%) with ulcerative colitis (UC). During follow-up, 38 patients (31.7%) experienced readmission, with a mean interval of 3.2±1.5 months. Multivariate analysis identified severe disease (OR = 3.85, 95% CI: 1.92-7.72), presence of complications (e.g., intestinal obstruction, perforation, or intra-abdominal abscess; OR = 3.22, 95% CI: 1.65-6.30), and C-reactive protein (CRP) levels ≥2 times the upper limit of normal (OR = 2.98, 95% CI: 1.51-5.88) as independent risk factors for readmission. Conversely, treatment with biologics was protective factor (OR = 0.35, 95% CI: 0.16-0.76). The readmission rate was 58.3% in patients with severe disease versus 8.3% in those with mild disease, while only 10.0% of biologic-treated patients were readmitted, significantly lower than those receiving aminosalicylates (37.8%), corticosteroids (34.4%), or immunomodulators (30.4%). Conclusions: Hospitalized IBD patients are predominantly middle-aged males, with clinical features varying by disease subtype. Disease severity, complications, and elevated CRP levels significantly increase the risk of readmission, whereas biologic therapy is associated with a markedly reduced risk. Integrating these factors into clinical decision-making enables precision assessment and individualized interventions to improve outcomes and reduce hospital readmissions.

Keywords: Inflammatory bowel disease, hospitalized patients, clinical characteristics, readmission, risk factors, retrospective study

Introduction

Inflammatory bowel disease (IBD), mainly including Crohn's disease (CD) and ulcerative colitis (UC), is a group of chronic, relapsing inflammatory diseases of the gastrointestinal tract. IBD is characterized by marked clinical heterogeneity, with undetermined etiology [1, 2]. In recent years, the global epidemiological characteristics of IBD have changed significantly: while the incidence has stabilized in the traditionally high-prevalence areas, newly industrialized countries, including China, are experiencing a rapid increase in incidence [3-6]. This trend not only reflects the important roles of environmental factors, lifestyle and intestinal microecology in the pathogenesis of IBD, but also poses new challenges to China's healthcare service system [7]. Particularly, in addition to the common characteristics observed in Chinese IBD patients, such as significant variability in disease duration, difficulties in

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long-term management, high complication rates, and repeated hospitalizations, distinct differences in clinical manifestations exist between Chinese IBD patients and Western populations. These disparities include a higher proportion of colonic CD and a relatively lower prevalence of perianal lesions, underscoring the need to establish a diagnostic and prognostic evaluation system that is suitable for the Chinese population [8-11].

Acute exacerbations and disease-related complications of IBD often lead to hospitalization, and even surgical intervention in some cases. For instance, patients with CD are often hospitalized for intestinal obstruction, fistulas, and abdominal abscesses, whereas patients with UC are more prevalent to develop severe colitis, toxic megacolon, or uncontrollable hemorrhage [12-14]. Although therapeutic advances such as biologics and small molecule drugs have improved clinical outcomes in moderate-to-severe patients, readmission rates within one year of discharge remain as high as 20%-40%, reflecting persistent deficiencies in sustaining remission and complication prevention [15, 16]. The risk of readmission is influenced by multiple factors, including disease characteristics (early onset, extensive disease, complications, or surgical history), treatment-related factors (medication choice, timing of and adherence to treatment), and psychosocial and economic status [17, 18]. The significant differences in readmission rates among medical centers suggest uneven levels of care and highlight the need for a standardized post-discharge management system [19, 20].

In this context, it is particularly important to identify risk factors for readmission and establish effective prediction models. Studies have shown that disease severity, systemic inflammatory markers (e.g., C-reactive protein, fecal calreticulin), endoscopic mucosal healing status, and choice of treatment strategy (especially the use of biologics) are the key factors influencing the risk of readmission. However, research in this area in China is still lagging behind, lacking data from large-sample, multicenter clinical studies. Therefore, establishment of a risk prediction model based on the characteristics of the Chinese population that is suitable for the national situation is of great value in achieving individualized treatment and optimizing the allocation of medical resources.

Based on clinical data from a single center at Beijing Friendship Hospital, this retrospective study aimed to systematically characterize hospitalized IBD patients and to identify independent risk factors for readmission within 6-12 months after discharge. The results of the study are expected to inform risk identification and optimization of post-discharge management strategies in clinical practice, thereby reducing the clinical and health economic burden associated with recurrent hospitalization of patients with IBD.

Materials and methods

Study design and patient inclusion

In this study, IBD patients hospitalized in the Department of Gastroenterology of the Beijing Friendship Hospital of Capital Medical University between January 2019 and January 2023 were systematically screened. A total of 197 hospitalized IBD patients were identified in the initial screening. After screening with strict inclusion and exclusion criteria, 120 patients finally met the study criteria and were included in the analysis, with an overall inclusion rate of 60.9% (**Figure 1**). This retrospective study used anonymized clinical data extracted from electronic medical records. The requirement for individual informed consent was waived by the Ethics Committee of Beijing Friendship Hospital, Capital Medical University, in accordance with the Declaration of Helsinki (as revised in 2013).

Inclusion criteria: (1) Patients met the diagnostic criteria for IBD, as specified in the *Consensus Statements on the Diagnosis and Treatment of Inflammatory Bowel Disease* issued by the Inflammatory Bowel Disease Group of the Gastroenterology Branch of the Chinese Medical Association (2018). Specifically, the diagnosis of IBD was confirmed through a comprehensive assessment, including detailed medical history and physical examination; laboratory tests, including complete blood count [CBC], C-reactive protein [CRP], erythrocyte sedimentation rate [ESR], routine fecal examination, and fecal occult blood test); endoscopic examinations (e.g., colonoscopy, enteroscopy), and imaging examinations (e.g., abdominal computed tomography [CT], magnetic resonance imaging [MRI], small bowel radiography). (2) Patients aged between 18 and 80 years at the time of

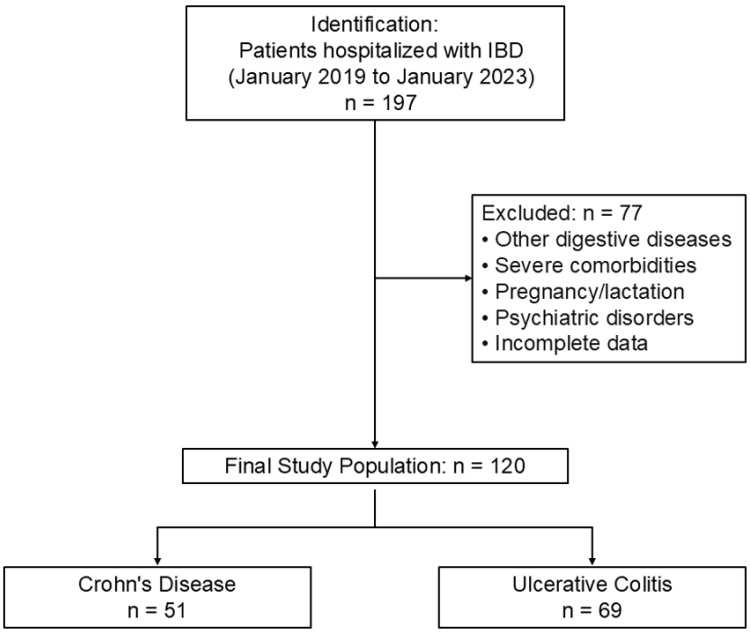

Figure 1. Patient screening flowchart.

hospitalization, covering various age groups to ensure broad representativeness of the study results.

Exclusion criteria: (1) Coexisting severe digestive system diseases, including gastrointestinal malignancies, decompensated cirrhosis, or moderate-to-severe acute pancreatitis; (2) Presence of other systemic serious diseases, including severe cardiac insufficiency, acute coronary syndrome, acute exacerbation of chronic obstructive pulmonary disease, end-stage renal disease, hematologic malignancies, or active autoimmune disease; (3) Pregnancy or lactation; (4) Severe psychiatric disorders, cognitive impairments, or inability to cooperate with the study procedures or complete follow-up.

Data collection and observation outcomes

Data were independently extracted from the electronic medical record system by two trained researchers using a standardized data collection form. Discrepancies were resolved through discussion or by consulting a third investigator. Collected variables included demographic data (e.g., age, gender, and body mass index [BMI]), clinical features (symptoms, disease duration, and smoking history), laboratory parameters (hemoglobin [Hb], white blood cell count [WBC], CRP, ESR, albumin, platelets, and D-dimer), endoscopic and imaging findings, treatment modalities (e.g., aminosalicylates, glucocorticoids, immunosuppressants, biologics, and surgery), and follow-up data (readmission events, time to readmission).

Primary outcome: Readmission rate, defined as re-hospitalization due to IBD-related symptoms or complications occurring within 6-12 months after hospital discharge.

Secondary outcomes and definitions: Disease severity: Classified as mild, moderate, or severe based on a composite assessment of BMI, CRP, albumin, and ESR (see Supplementary Material for detailed criteria).

CRP elevation: Defined as serum CRP level ≥2 times the upper limit of normal (≥10 mg/L).

Complications: Included intestinal obstruction, perforation, intra-abdominal abscess, fistula, toxic megacolon, or massive hemorrhage, as confirmed by imaging studies or surgical findings.

Study methods: This study adopted a retrospective design, and the analysis was primarily based on existing clinical medical record data. This method enabled efficient utilization of comprehensive medical records without affecting routine patient care, offering advantages of rapid data acquisition, short research period, and lower cost, while avoiding ethical concerns.

During data management, collected clinical information was categorized and entered into an electronic database. A preliminary data review was first conducted to verify the completeness, accuracy and consistency of the information, and missing or abnormal values were reviewed and corrected. Categorical variables (e.g., sex, disease type, and treatment modality) were coded uniformly, and

Table 1. Baseline characteristics of inpatients with IBD

Characteristics	Total (n = 120)	CD group (n = 51)	UC group (n = 69)	χ^2/t	P
Age (years, mean ± SD)	42.5±12.3	32.5±12.3	45.2±15.7	5.234	<0.001
Male, n (%)	68 (56.7)	35 (68.6)	33 (47.8)	5.678	0.018
BMI (kg/m^2, mean ± SD)	21.21±4.52	20.82±4.23	21.52±4.82	1.245	0.215
Length of Hospital Stay (mean ± SD)	15.72±10.82	14.22±8.52	16.82±12.32	1.712	0.089
Disease Duration (years, mean ± SD)	5.82±4.02	6.82±4.32	5.22±3.72	2.167	0.032
Smoking History, n (%)	45 (37.5)	22 (43.1)	23 (33.3)	1.345	0.247
Surgical History, n (%)	23 (19.2)	15 (29.4)	8 (11.6)	6.945	0.008

Notes: IBD, Inflammatory Bowel Disease; CD, Crohn's Disease; UC, Ulcerative Colitis; SD, Standard Deviation; BMI, Body Mass Index.

Table 2. Comparison of laboratory indicators between the two groups

Indicator	CD group (n = 51)	UC group (n = 69)	t	*P*-value
Hemoglobin (Hb, g/L, mean ± SD)	115.22±25.62	128.72±28.32	2.401	0.018
White Blood Cell (WBC, ×10^9/L, mean ± SD)	7.82±3.22	8.52±4.12	1.542	0.125
C-Reactive Protein (CRP, mg/L, mean ± SD)	28.52±35.22	32.12±42.62	1.245	0.215
Albumin (g/L, mean ± SD)	36.22±6.82	38.52±7.22	2.023	0.045
Erythrocyte Sedimentation Rate (ESR, mm/h, mean ± SD)	32.82±24.52	45.22±28.72	2.167	0.032
Platelets (PLT, ×10^9/L, mean ± SD)	285.62±125.32	312.82±138.42	1.089	0.278
D-Dimer (mg/L, mean ± SD)	0.68±0.45	0.82±0.63	1.345	0.181

Notes: CD, Crohn's Disease; UC, Ulcerative Colitis; Hb, Hemoglobin; WBC, White Blood Cell; CRP, C-Reactive Protein; SD, Standard Deviation; ESR, Erythrocyte Sedimentation Rate; PLT, Platelets.

continuous variables (e.g., age and various laboratory indicators) were standardized to ensure consistency in data format and to facilitate subsequent statistical analyses.

Statistical analysis

SPSS 26.0 was used for data analysis. Measurement data conforming to normal distribution were expressed as mean ± standard deviation, and comparisons between groups were performed by independent-samples t-test (two groups) or one-way ANOVA (multiple groups). Categorical data we expressed as the number of cases and percentage [n (%)], and comparisons between groups were performed by χ^2 test. Non-parametric rank-sum tests were used for ordinal (ranked) data. Univariate and multivariate logistic regression analysis were performed to identify independent factors for rehospitalization in patients with IBD, with odds ratios (ORs) and their 95% confidence intervals (CIs) calculated. A *P* value <0.05 was considered statistically significant.

Results

Baseline characteristics

A total of 120 patients with IBD who were hospitalized in the Department of Gastroenterology, Beijing Friendship Hospital of Capital Medical University between January 2019 and January 2023 were included in this study. Among them, 51 (42.5%) patients were diagnosed with CD and 69 (57.5%) with UC. The mean age of patients with CD was (32.5±12.3) years, significantly lower than that of patients with UC (45.2±15.7) years (P<0.001). In terms of gender distribution, the CD group had a higher proportion of males (68.6%), whereas the UC group had a relatively balanced gender distribution (47.8% males). The analysis of BMI and length of hospitalization showed no significant difference between the two groups. The details are shown in **Table 1**.

Laboratory parameters

Laboratory parameters demonstrated distinct profiles between CD and UC patients (**Table 2**).

Table 3. Comparison of treatment patterns between the two groups

Treatment Modality	CD group (n = 51)	UC group (n = 69)	χ^2	*P*-value
Aminosalicylates, n (%)	15 (29.4)	51 (73.9)	25.678	<0.001
Glucocorticoids, n (%)	30 (58.8)	45 (65.2)	0.567	0.225
Immunosuppressants, n (%)	18 (35.3)	12 (17.4)	6.345	0.012
Biologics, n (%)	18 (35.3)	12 (17.4)	6.345	0.012
Surgical intervention, n (%)	15 (29.4)	8 (11.6)	6.945	0.008
Enteral nutrition, n (%)	8 (15.7)	3 (4.3)	5.234	0.022

Notes: CD, Crohn's Disease; UC, Ulcerative Colitis.

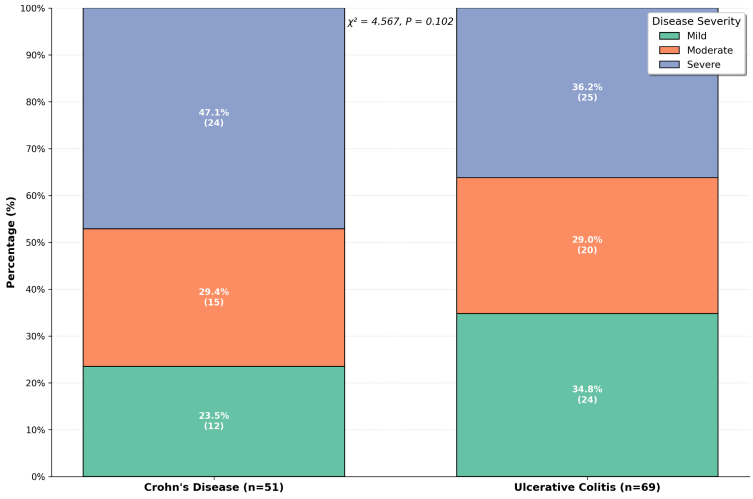

Figure 2. Distribution of disease severity.

Table 4. Comparison of incidence of complications between the two groups

Type of Complication	CD group (n = 51)	UC group (n = 69)	χ^2	*P*-value
Intestinal Obstruction, n (%)	18 (35.3)	5 (7.2)	15.678	<0.001
Intra-abdominal Abscess, n (%)	7 (13.7)	2 (2.9)	5.234	0.022
Intestinal Fistula, n (%)	5 (9.8)	1 (1.4)	4.567	0.033
Toxic Megacolon, n (%)	0 (0)	6 (8.7)	4.678	0.031
Massive Hemorrhage, n (%)	3 (5.9)	8 (11.6)	1.234	0.267
Any Complication, n (%)	32 (62.7)	29 (42.0)	5.678	0.015

Notes: CD, Crohn's Disease; UC, Ulcerative Colitis.

Inflammatory marker analysis revealed a significantly higher ESR in the UC group compared to the CD group (P = 0.032), while CRP levels did not differ significantly. Assessment of nutritional status indicated that CD patients had lower hemoglobin levels, along with higher rates of anemia and hypoalbuminemia, compared with UC patients (all P<0.05). No significant intergroup differences were observed in WBC, PLT or D-dimer levels.

Treatment patterns

Significant differences in treatment patterns were observed between the two groups (**Table 3**). Aminosalicylates were more commonly used in UC patients, while biologics were administered more frequently in the CD group (P = 0.012). Glucocorticoid use was similar between groups. The history of intestinal surgery was significantly more common in CD patients than in UC patients (P = 0.008), with ileocolic resection and total colectomy being the predominant procedures in CD and UC, respectively.

Disease severity and complications

Disease severity and complication profiles differed notably between CD and UC patients. Severe disease was more common in the CD group, whereas mild disease was more frequent among UC patients (**Figure 2**). Overall, complications occurred significantly more often in CD patients than in UC patients (P = 0.015). The most common complications in CD patients included intestinal obstruction, abdominal abscess, and enterocutaneous fistula, whereas toxic megacolon and massive hemorrhage predominated in UC patients (**Table 4**).

Analysis of risk factors for rehospitalization

During the 6-12-month follow-up period, 31.7% of patients (38/120) experienced readmission, with a mean interval to readmission of 3.2 months. Univariate analysis identified several factors associated with readmission risk, including age, disease severity, presence of com-

Table 5. Univariate analysis of factors associated with readmission

Factor	Readmission Group (n = 38)	Non-Readmission Group (n = 82)	χ^2/t	*P*-value
Age (years, mean ± SD)	46.8±13.2	40.3±11.5	2.789	0.006
Disease type (CD vs UC)	18 vs 20	33 vs 49	0.456	0.499
Severe disease activity, n (%)	21 (55.3)	15 (18.3)	18.234	<0.001
Presence of complications, n (%)	22 (57.9)	16 (19.5)	17.456	<0.001
Biologic therapy, n (%)	4 (10.5)	26 (31.7)	6.945	0.008
CRP (mg/L, mean ± SD)	45.62±38.22	24.32±26.82	3.456	0.001
ESR (mm/h, mean ± SD)	52.32±31.52	35.22±22.82	3.123	0.002
Anemia, n (%)	25 (65.8)	25 (30.5)	13.789	<0.001
Hypoalbuminemia, n (%)	20 (52.6)	20 (24.4)	9.456	0.002

Notes: CD, Crohn's Disease; UC, Ulcerative Colitis; SD, Standard Deviation; CRP, C-Reactive Protein; ESR, Erythrocyte Sedimentation Rate.

plications, treatment type, CRP and ESR levels, and anemia status (all P<0.05; **Table 5**). Multivariate logistic regression further identified severe disease activity (OR = 3.85), the presence of complications (OR = 3.22), and elevated CRP (≥2×ULN; OR = 2.98) as independent risk factors for readmission, while biologic therapy was independently associated with a reduced risk of readmission (OR = 0.35). Consistently, readmission rates were highest among patients with severe disease, those with complications, and those with markedly elevated CRP, and lowest in patients receiving biologic therapy (**Figure 3**).

Discussion

Inflammatory bowel disease (IBD) is a chronic, relapsing inflammatory disease of the gastrointestinal tract with significant heterogeneity and an unpredictable course. Its global incidence has increased steadily [16, 17], particularly in newly industrialized countries such as China, resulting in a growing burden on healthcare systems [21-23]. During disease progression, acute exacerbation and complications of IBD may lead to hospitalization, and even surgical interventions in some severe cases. The rehospitalization rate remains as high as 20-40% within one year after discharge, underscoring the fragility of disease control [24] and highlighting the limitations of the existing treatment strategies in sustaining long-term remission, which represents a major challenge in current clinical management of IBD [8, 25]. Although the use of biologics and small molecule drugs has improved the clinical outcomes of patients with moderate-to-severe disease, accurate identification of those at high risk of rehospitalization and optimization of treatment strategies remain major challenges in clinical practice [9-11, 26, 27]. Previous studies have sought to identify factors affecting rehospitalization in patients with IBD, including disease behavior, inflammatory load, treatment choices, and comorbidities [22, 25, 28]. However, high-quality evidence from the Chinese population remains limited, and the interactions among the factors and their combined impact on the risk of rehospitalization have yet to be fully clarified [23, 29, 30].

In this context, the present study retrospectively analyzed the clinical data of 120 hospitalized patients with IBD, aiming to identify independent risk factors for rehospitalization. The results showed that disease severity, complication status, CRP level and the use of biologic therapy status were key factors influencing rehospitalization. The patients included in this study were predominantly young and middle-aged, and the age of onset of CD patients was earlier than that of UC, and males were predominant, which is consistent with previous reports in China [7]. In terms of clinical manifestations, CD was characterized by abdominal pain, diarrhea and weight loss, while UC manifested with diarrhea and hematochezia, which is consistent with the typical phenotypic differences between the two types of diseases. Laboratory tests further suggested that patients with CD were more likely to experience impaired nutritional status, as evidenced by a higher incidence of anemia and hypoprotein-

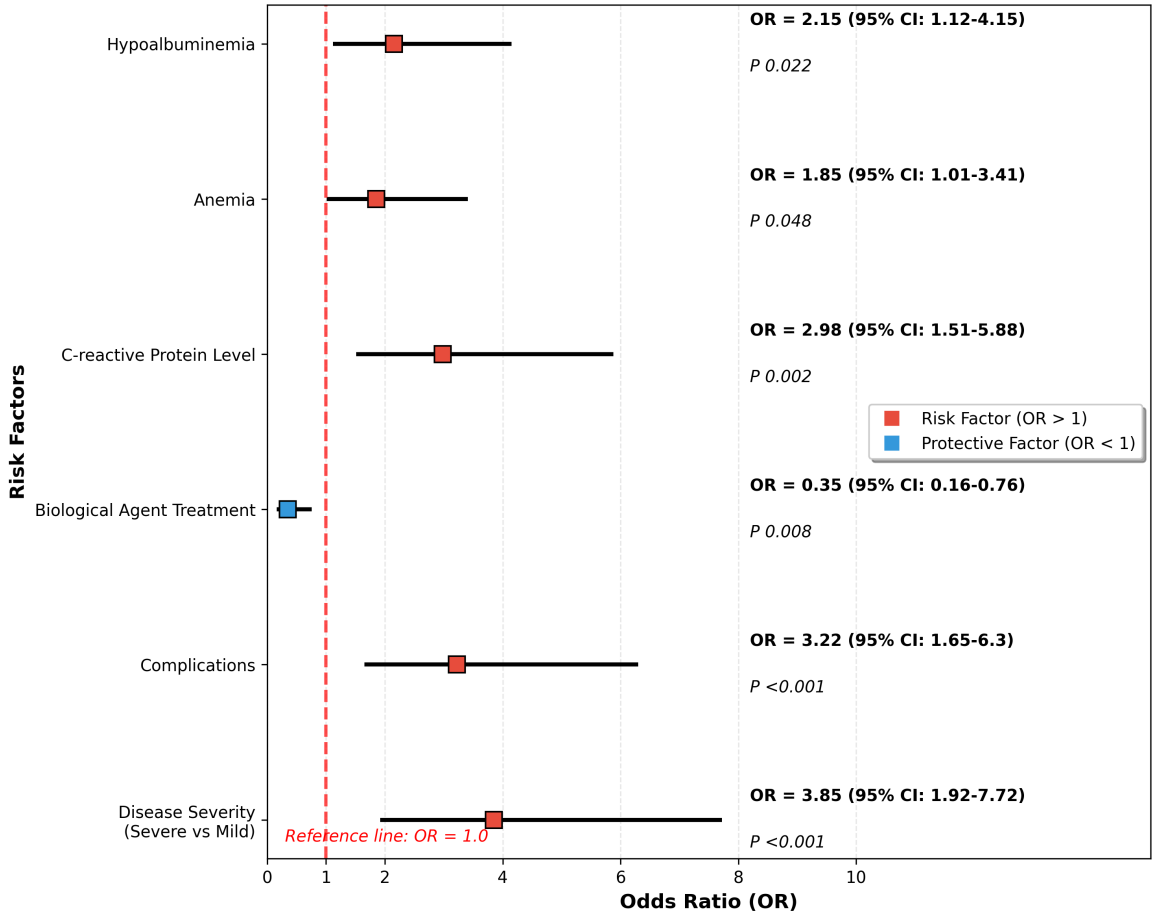

Figure 3. Forest plot of risk factors for rehospitalization. Notes: OR, Odds Ratio; CI, Confidence Interval.

emia, whereas patients with UC had a more pronounced systemic inflammatory response (represented by elevated ESR).

This study, based on single-center clinical data, found that disease severity was the strongest predictor of rehospitalization (OR = 3.85). This is consistent with the results of a multicenter study by Bourgonje et al., showing a 3.2-fold increased risk of rehospitalization within 6 months in patients with severe active IBD compared with those with mild disease [13]. Multifactorial analysis showed that comorbidities significantly increased the risk of rehospitalization (OR = 3.22), which is consistent with the findings of previous studies. In this study, the incidence of complications was significantly higher in the CD group (62.7%) than in the UC group, with intestinal obstruction (35.3%) and abdominal abscess (13.7%) being the most common. Such complications often required surgical intervention or long-term pharmacologic treatment, which significantly prolonged the treatment cycle. Notably, the impact of different complications on the risk of rehospitalization varied, with intestinal obstruction and enterocutaneous fistulae being of particular risk as they often required multiple hospitalizations. Elevated CRP (≥2 times the upper limit of normal) was independently associated with the risk of rehospitalization (OR = 2.98). Data from this study showed that the rehospitalization rate (54.2%) in patients with elevated CRP was significantly higher than that of the normal group, supporting the use of CRP as a routine follow-up indicator for the assessment of disease activity and prognosis prediction. Treatment with biologics demonstrated a significant protective effect (OR = 0.35), reducing the risk of rehospitalization by 65%. Despite its clear clinical value, the utilization rate in this study was low (35.3% in the CD group and 17.4% in the UC group), reflecting the current status of treatment in China. By precisely inhibiting key

inflammatory pathways, biologics promote mucosal healing while controlling symptoms, thereby effectively reducing the risk of recurrence.

Although the results of this study have important clinical value, several limitations need to be recognized. First, the single-center retrospective design and relatively small sample size may affect the generalizability of the results. Second, some potential confounders, such as treatment adherence and smoking status, were not fully corrected for. Third, the relatively short follow-up period precluded assessment of long-term readmission rates. Future multicenter prospective studies combining endoscopic and imaging biomarkers are needed to further optimize risk prediction models and to comprehensively evaluate the impact of different biologic agents and combination therapy strategies on readmission risk.

Conclusion

Hospitalized patients with IBD are predominantly young and middle-aged males. There are significant differences between Crohn's disease and ulcerative colitis in terms of clinical presentation, disease behavior, and treatment patterns. Severe disease activity, complications such as bowel obstruction or abscess, and significantly elevated CRP levels are independent risk factors for readmission, while biologic therapy is associated with reduced risk of readmission. These findings suggest that individualized treatment and targeted follow-up strategies based on disease severity, inflammatory markers, and comorbid conditions - especially early use of biologics in high-risk patients - may improve outcomes and reduce the burden of hospital readmission.

Disclosure of conflict of interest

None.

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Supplementary Material

Criteria for Disease Severity Classification

Disease severity was classified as mild, moderate, or severe based on a composite assessment of four objective parameters: body mass index (BMI), C-reactive protein (CRP), serum albumin, and erythrocyte sedimentation rate (ESR). The classification was performed according to the following predefined criteria:

Severity	Criteria (must meet at least one of the following)
Mild	All of the following:
	• BMI ≥ 18.5 kg/m^2
	• CRP < 10 mg/L (i.e., < 2 × upper limit of normal)
	• Albumin ≥ 35 g/L
	• ESR < 30 mm/h
Moderate	Any one or two of the following (but not meeting severe criteria):
	• BMI < 18.5 kg/m^2
	• CRP 10-50 mg/L (2-10 × upper limit of normal)
	• Albumin 30-34.9 g/L
	• ESR 30-60 mm/h
Severe	Any two or more of the following:
	• BMI < 18.5 kg/m^2
	• CRP > 50 mg/L (> 10 × upper limit of normal)
	• Albumin < 30 g/L
	• ESR > 60 mm/h

The upper limit of normal for CRP was defined as 5 mg/L, in accordance with the laboratory reference range used at our institution. The thresholds for each parameter were selected based on widely accepted clinical cut-offs and prior literature to ensure consistency and reproducibility. The composite assessment was applied uniformly to all patients, irrespective of disease subtype (Crohn's disease or ulcerative colitis). In cases where a patient's laboratory values spanned different severity levels, the highest applicable severity category was assigned.