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Potential Categories and Influencing Factors of Social Participation Among Colorectal Cancer Patients

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Abstract:

Objective: To explore the characteristics of potential categories of social participation among colorectal cancer patients, analyze the influencing factors associated with different categories, and provide empirical evidence for the development of precision-based social functional rehabilitation intervention plans.

Methods: A cross-sectional study design was employed. A total of 368 colorectal cancer patients from the Department of Gastrointestinal Surgery, Department of Medical Oncology, and Stoma Clinic of a tertiary hospital between January and December 2024 were selected as study subjects. Data were collected using a demographic questionnaire, the Social Participation Scale for Chronic Patients, the Hospital Anxiety and Depression Scale, the Social Support Rating Scale, the Barthel Index, and the Piper Fatigue Scale. Latent class analysis of social participation was conducted using Mplus 8.3 software, and SPSS 26.0 was used to explore the factors influencing class membership through univariate analysis and multinomial logistic regression models.

Results: Social participation among colorectal cancer patients can be classified into three latent categories: the group with good social participation (32.07%), the group with partially restricted social participation (45.11%), and the group with severely restricted social participation (22.82%). Multiclass logistic regression analysis revealed that age, TNM stage, stoma presence, number of comorbid chronic diseases, anxiety level, social support level, activities of daily living (ADL) ability, and cancer-related fatigue were independent factors influencing patients' social participation categories ($P < 0.05$), while depression level was a specific independent risk factor for the severely restricted social participation category ($P < 0.05$).

Conclusion: Significant heterogeneity exists in the social participation of colorectal cancer patients. Clinicians should prioritize high-risk patients, including the elderly, those with a stoma, advanced-stage disease, multiple comorbidities, and negative emotions. By developing stratified and precise rehabilitation intervention strategies tailored to the characteristics and core influencing factors of different subgroups, clinicians can promote the restoration of patients' social functioning and improve their long-term quality of life.

Keywords:

colorectal cancer; social participation; latent class analysis; influencing factors

Colorectal cancer is one of the most common malignant digestive tract cancers worldwide. According to GLOBOCAN 2022 data, there were approximately 1.93 million new cases and 940,000 deaths from colorec-

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tal cancer globally, ranking third in incidence and second in mortality among all malignant tumors. In China, the disease burden of colorectal cancer continues to rise. According to the latest cancer registry data released by the National Cancer Center, annual new cases of colorectal cancer in China have exceeded 400,000, ranking second among all malignant tumors. It has become a major public health issue that seriously threatens the health of the Chinese population. In recent years, with the comprehensive promotion of early diagnosis and treatment strategies, as well as continuous advancements in minimally invasive surgical techniques and multidisciplinary integrated treatment models, the 5-year survival rate for colorectal cancer patients in China has significantly improved. A large number of patients have entered a phase of long-term survival with the disease or postoperative recovery, and their rehabilitation needs have gradually shifted from the traditional focus on extending survival and controlling physical symptoms to the comprehensive restoration of physiological, psychological, and social functioning.

The World Health Organization's International Classification of Functioning, Disability and Health (ICF) identifies social participation as a core dimension of human functioning and health, defining it as the behaviors and capabilities through which individuals integrate into family, community, and social environments, fulfill social roles, and engage in social activities and affairs. It serves as a key outcome measure for assessing the overall rehabilitation status and quality of life of cancer patients. For colorectal cancer patients, the chronic physical toll of the disease itself, surgical trauma (particularly permanent stomas), adverse effects of radiotherapy and chemotherapy, bowel dysfunction, cancer-related fatigue, and negative emotions such as anxiety and depression all weaken their capacity for social participation and limit their social engagement to varying degrees. Previous studies have confirmed that limited social participation not only exacerbates patients' stigma and psychological distress, reduces treatment adherence and self-management capabilities, but also increases the risk of malnutrition, complications, and readmission, severely compromising patients' long-term quality of life and prognosis.

Currently, most domestic and international studies on social participation among colorectal cancer patients employ variable-centered analytical strategies, treating social participation as a single continuous variable to explore its influencing factors. This approach overlooks the heterogeneity of social participation characteristics within the patient population, making it difficult to accurately identify high-risk subgroups with similar patterns of restricted social participation. Consequently, clinical interventions often adopt a "one-size-fits-all" approach, failing to meet the individualized rehabilitation needs of patients with different characteristics. Latent Class Analysis (LCA) is an individual-centered heterogeneity analysis method that groups study subjects with homogeneous characteristics into the same latent class based on the response patterns of observed indicators. It not only clearly delineates the social participation characteristics of different patient subgroups but also provides targeted intervention points for subsequent stratified interventions. In recent years, LCA has been widely applied in heterogeneity studies of health behaviors and functional outcomes among patients with chronic diseases. Currently, systematic research on the latent category characteristics and influencing factors of social participation among colorectal cancer patients in China remains scarce, and the distribution patterns and key influencing factors of social participation among local Chinese colorectal cancer patients have not yet been clearly identified.

Accordingly, this study aims to conduct a cross-sectional survey of colorectal cancer patients. Using latent

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class analysis, we will identify the heterogeneous subgroup characteristics of patients' social participation and further analyze the factors influencing class membership. The study aims to provide empirical evidence to help clinical healthcare professionals identify high-risk populations with limited social participation at an early stage and develop stratified, precision-based social functional rehabilitation intervention plans, thereby contributing to the improvement of the comprehensive rehabilitation management system for colorectal cancer patients.

1 Subjects and Methods

This study is a cross-sectional study and was conducted in strict accordance with the STROBE (Standardization of Reports of Observational Studies in Epidemiology) guidelines.

1.1 Study Population

The study population consisted of colorectal cancer patients who visited the Department of Gastrointestinal Surgery, Department of Medical Oncology, Ostomy Clinic, and Department of Rehabilitation Medicine at a Grade A tertiary hospital affiliated with XX University between January and December 2024.

1.1.1 Inclusion Criteria

① Patients diagnosed with primary colorectal cancer based on histopathological examination; ② Age ≥ 18 years; ③ Diagnosed for ≥1 month and currently in the postoperative recovery, adjuvant therapy, or maintenance therapy phase; ④ Alert and oriented, with no speech, hearing, or communication impairments, and able to complete the questionnaire independently or with the investigator's assistance; ⑤ Voluntarily participating in this study and having signed a written informed consent form.

1.1.2 Exclusion Criteria

① Patients with concurrent primary malignant tumors; ② Patients with AJCC 8th Edition TNM Stage IV tumors accompanied by distant metastasis or in the terminal stage of the disease, who are unable to cooperate with the study; ③ Patients with severe functional failure of vital organs such as the heart, brain, liver, or kidneys, or those with a history of mental illness or cognitive impairment; ④ Patients currently participating in other clinical studies related to similar rehabilitation interventions.

1.1.3 Sample Size Estimation

The sample size is determined based on two core requirements: ① Sample requirements for Latent Class Analysis (LCA); previous methodological studies and similar clinical trials have confirmed that a minimum of 300 cases is required for a stable fit of the LCA model; ② Sample requirements for multivariate logistic regression analysis: based on the 1:10 rule for the number of events relative to the number of independent variables, and considering the 15 independent variables to be included in this study, a minimum of 150 cases is required. Combining these two requirements and anticipating a 10% invalid questionnaire return rate, this study plans to enroll no fewer than 380 participants.

1.2 Research Tools

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1.2.1 Demographic Questionnaire

Designed by the research team based on the study objectives and a literature review, it consists of two sections: ① Demographic and sociological data: age, gender, marital status, educational level, current employment status, monthly per capita household income, type of health insurance, living arrangements, and information on the primary caregiver; ② Disease-related data: tumor site, AJCC 8th Edition TNM staging, duration since diagnosis, previous treatments received (surgery, chemotherapy, radiation therapy, targeted therapy, immunotherapy, etc.), presence of a stoma, stoma type, number of comorbid chronic conditions, and presence of postoperative or treatment-related complications.

1.2.2 Social Participation Assessment Tool

The Social Participation Scale for Patients with Chronic Diseases, revised by Li Xianwen et al. in 2015, was adopted. This scale was developed based on the WHO International Classification of Functioning, Disability and Health (ICF) framework and is specifically designed for the chronic disease population in China, demonstrating good local adaptability, reliability, and validity. The scale comprises three dimensions—role activities, social interaction, and outdoor activities—with a total of 20 items. Each item uses a 5-point Likert scale (1 = completely unable to participate; 5 = completely able to participate), with a total score ranging from 20 to 100 points; a higher score indicates better social participation levels and capabilities. This scale is widely used among cancer and chronic disease patients in China. The Cronbach's α coefficient for the original scale was 0.923, while in this study, the Cronbach's α coefficient for the total scale was 0.918.

1.2.3 Assessment Tools for Associated Factors

Hospital Anxiety and Depression Scale (HADS): Developed by Zigmond et al. and adapted for the Chinese context by domestic scholars, this is a commonly used tool for screening psychological distress in cancer patients. The scale consists of two subscales—anxiety and depression—each containing seven items. Each item is scored on a 4-point scale ranging from 0 to 3, with a total score of 0 to 21 for each subscale. A score of ≥8 indicates clinically significant anxiety or depressive symptoms. In this study, the Cronbach's α coefficient for the total scale was 0.876.

Social Support Rating Scale (SSRS): Developed by Xiao Shuiyuan, this is the most widely used social support assessment tool in China. It comprises three dimensions—objective support, subjective support, and utilization of support—with a total of 10 items. The total score ranges from 12 to 66 points, with higher scores indicating a higher level of social support received by the patient. In this study, the Cronbach's alpha coefficient for this scale was 0.895.

Barthel Index (BI): Used to assess patients' ability to perform activities of daily living, it includes 10 items such as eating, washing, dressing, toileting, walking, and climbing stairs. The total score ranges from 0 to 100; a higher score indicates better self-care ability and milder physical functional impairment. This scale is widely used in the field of cancer rehabilitation in China and has demonstrated good reliability and validity.

Revised Piper Fatigue Scale (RPFS): Used to assess the severity of cancer-related fatigue in patients. It comprises four dimensions—behavior/severity, emotional, sensory, and cognitive/mood—with a total of 22

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items. Each item is scored on a scale of 0–10, and the total score is converted to a range of 0–10; a higher score indicates more severe fatigue. In this study, the Cronbach's α coefficient for this scale was 0.931.

1.3 Data Collection Methods

Prior to the survey, all participating researchers underwent standardized training. The training covered the study objectives, explanations of questionnaire items, standardized instructions, doctor-patient communication skills, quality control protocols, and requirements for questionnaire verification and data entry. Researchers were only permitted to begin data collection after passing both theoretical and practical assessments.

At the survey site, investigators used standardized instructions to explain study-related matters to patients meeting the inclusion criteria and distributed the questionnaire after obtaining informed consent. Patients completed the questionnaire independently and anonymously; the completion time was approximately 15–20 minutes. For patients with poor vision, limited mobility, or difficulty writing, the investigator reads each item aloud using non-leading, neutral language, strictly recording the patient's independent responses without providing subjective guidance throughout the process.

After the questionnaire is completed, the investigator conducts a comprehensive on-site review. For items that are missing, incorrect, or contain logical contradictions, the investigator promptly verifies the information with the patient and makes corrections; Questionnaires with a missing rate of core items exceeding 20% were deemed invalid and excluded. The collected valid questionnaires were independently double-entered by two trained researchers to establish a standardized database. After data entry, the records were cross-checked, and a full database logical verification and outlier cleaning were performed to ensure data accuracy and completeness.

1.4 Statistical Methods

Data analysis was performed using SPSS 26.0 and Mplus 8.3 software. The significance level was set at $\alpha = 0.05$, and two-tailed tests were used.

Descriptive Statistics: Quantitative data following a normal distribution were described as mean ± standard deviation ($x \pm s$); non-normally distributed quantitative data were described as median (interquartile range) [M (P25,P75)]; and categorical data were described as frequency (proportion, %).

Latent Class Model Construction: Using the scores on the three dimensions of the Social Participation Scale for Patients with Chronic Diseases as manifest variables, latent class models with 1 to 5 categories were fitted sequentially. The optimal number of categories was determined based on goodness-of-fit indices and clinical interpretability. Key fit indices include: Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), and adjusted Bayesian Information Criterion (aBIC). Smaller values for these three indices indicate better model fit; Entropy, with a range of 0 to 1, where values closer to 1 indicate higher classification accuracy and more reliable classification results; the Lo-Mendell-Rubin Likelihood Ratio Test (LMRT) and the Bootstrap Likelihood Ratio Test (BLRT). If the P-value for both tests is <0.05, this indicates that the model with k categories fits significantly better than the model with k-1 categories. Finally, the optimal latent category model is determined by combining model fit metrics, classification accuracy, professional relevance,

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and clinical interpretability.

Univariate Analysis: Chi-square tests were used to compare differences in the counts of patients across different latent categories; for continuous variables following a normal distribution, one-way ANOVA was used for between-group comparisons, while for those not following a normal distribution, the Kruskal-Wallis H test was used to identify variables with statistically significant differences between groups ($P < 0.05$).

Multivariate analysis: Using the identified optimal latent category as the dependent variable and the variables with statistically significant differences from the univariate analysis as independent variables, we constructed a multivariate unordered logistic regression model to analyze the independent factors influencing the latent categories of social participation in colorectal cancer patients. Results were presented as regression coefficients (β), odds ratios (OR), and 95% confidence intervals (CI).

2 Results

Data processing in this study was conducted in strict accordance with the pre-established statistical analysis plan. All tests were two-sided, with a significance level of $\alpha = 0.05$.

2.1 Demographic Characteristics of the Study Participants

A total of 390 questionnaires were distributed, and 368 valid questionnaires were returned, resulting in a valid response rate of 94.36%.

The 368 colorectal cancer patients ranged in age from 18 to 89 years, with a mean age of (63.25 ± 10.72) years; 209 were male (56.79%) and 159 were female (43.21%); 326 were married (88.59%); educational attainment was primarily at the junior high school level or below, totaling 201 cases (54.62%); 72 cases (19.57%) were employed, while 296 cases (80.43%) were retired, unemployed, or not in the workforce.

Disease-related data: The primary tumor site was the colon in 192 cases (52.17%) and the rectum in 176 cases (47.83%); according to the 8th edition of the AJCC TNM staging system: Stage I in 78 cases (21.20%), Stage II in 152 cases (41.30%), Stage III: 138 cases (37.50%); patients with a permanent stoma: 112 cases (30.43%); patients with one or more comorbid chronic diseases: 217 cases (58.97%); duration since diagnosis: 1–120 months, with a median of 18 (7, 36) months.

Scale assessment results: The total score on the Patient Social Participation Scale was (58.63 ± 18.72) points, with scores of (19.27 ± 7.05) points for the role activity dimension, (20.15 ± 6.88) points for the social interaction dimension, and (19.21 ± 7.26) points for the outdoor activity dimension; Hospital Anxiety and Depression Scale (HADS): Anxiety dimension (7.24 ± 3.86) points, Depression dimension (6.85 ± 3.72) points; Social Support Rating Scale (SSRS) total score (34.62 ± 7.85) points; Barthel Index (BI): (85.36 ± 17.24) points; Piper Fatigue Scale (RPFS) total score: (4.28 ± 2.15) points.

Complete demographic and disease-related data for the study subjects are presented in Table 1.

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Table 1 General characteristics of 368 colorectal cancer patients

Item	Category	Number (n)	Proportion (%)
Gender	Male	209	56.79
	Female	159	43.21
age（years）	<60	121	32.88
	60~74	186	50.54
	≥75	61	16.58
Marital status	Married	326	88.59
	Unmarried/Divorced / Widowed	42	11.41
Educational level	Primary school or below	87	23.64
	Junior high school	114	30.98
	Senior high school / Technical secondary school	96	26.09
	College or above	71	19.29
Occupational status	Employed	72	19.57
	Retired / Unemployed	296	80.43
Monthly per capita household income	<3000 yuan	102	27.72
	3000~5000 yuan	165	44.84
	>5000 yuan	101	27.45
Type of medical insurance	Urban-rural resident medical insurance	198	53.80
	Urban employee medical insurance	162	44.02
	Others	8	2.17
Living arrangement	Living with family	332	90.22
	Living alone	36	9.78
Primary tumor site	Colon	192	52.17
	Rectum	176	47.83
TNM stage	Stage I	78	21.20
	Stage II	152	41.30

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Item	Category	Number (n)	Proportion (%)
	Stage III	138	37.50
Ileostomy placement	No	256	69.57
	Yes	112	30.43
Number of comorbid chronic diseases	0 种	151	41.03
	1 种	132	35.87
	≥2 种	85	23.10
Duration since diagnosis	<6 m	98	26.63
	6 m ～ 2 y	176	47.83
	>2 y	94	25.54
Main treatment method	Surgery + adjuvant therapy	287	77.99
	Surgery alone	52	14.13
	Non-surgical comprehensive therapy	29	7.88
Continuous data	-	$\bar{x}\pm s$/ M(P25,P75)	-
Age (years)	-	63.25±10.72	-
Duration since diagnosis (months)	-	18(7,36)	-
Total score of Social Participation Scale	-	58.63±18.72	-
Anxiety dimension score	-	7.24±3.86	-
Depression dimension score	-	6.85±3.72	-
Total score of Social Support Rating Scale	-	34.62±7.85	-
Barthel Index	-	85.36±17.24	-
Total score of Cancer-related Fatigue Scale	-	4.28±2.15	-

-

2.2 Results of the Latent Category Analysis of Social Participation Among Colorectal Cancer Patients

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In this study, scores on the three dimensions of the Social Participation Scale—role activities, social interaction, and outdoor activities—were used as manifest variables. Latent category models with 1 to 5 categories were fitted sequentially; the goodness-of-fit indices for each model are shown in Table 2.

Table 2 Goodness-of-fit indices for latent category models of social participation among colorectal cancer patients

Number of Classes	AIC	BIC	aBIC	Entropy	LMRT (P value)	BLRT (P value)
1 -class	7826.312	7849.725	7833.104	1.000	-	-
2 -class	7315.628	7358.569	7327.421	0.865	<0.001	<0.001
3 -class	7028.194	7090.663	7044.988	0.892	<0.001	<0.001
4 -class	6987.451	7069.448	7009.246	0.876	0.127	<0.001
5 -class	6962.307	7063.832	6989.103	0.851	0.215	0.082

Note: AIC = Akaike Information Criterion, BIC = Bayesian Information Criterion, aBIC = sample size-adjusted Bayesian Information Criterion, Entropy = Entropy, LMRT = Lo-Mendell-Rubin Likelihood Ratio Test, BLRT = Bootstrap Likelihood Ratio Test.

The results show that as the number of categories increases, the AIC, BIC, and aBIC values generally exhibit a continuous downward trend; When fitting a 3-category model, the entropy value was 0.892 (close to 1), indicating high classification accuracy and reliable results. Additionally, both the LMRT and BLRT tests yielded $P < 0.001$, suggesting that the 3-category model fits the data significantly better than the 2-category model; When fitting a 4-category model, the LMRT test yielded $P = 0.127$, which was not statistically significant, indicating that the 4-category model did not offer a significant advantage over the 3-category model in terms of fit. Based on a comprehensive evaluation of model fit metrics, classification accuracy, professional relevance, and clinical interpretability, the 3-category model was ultimately determined to be the optimal model.

Based on the conditional probabilities and scoring characteristics of the three categories across the dimensions of social participation, the groups were named and described as follows:

Group with Good Social Participation: A total of 118 cases, accounting for 32.07% of the total sample. Patients in this group scored at the highest level across the three dimensions of role activities, social interaction, and outdoor activities. The conditional probabilities for each dimension were all > 0.85, indicating that social participation function was well-maintained across all dimensions with no obvious signs of limitation.

Group with Partially Restricted Social Participation: A total of 166 cases, accounting for 45.11% of the total sample. Patients in this group had relatively high scores in the social interaction dimension, while scores in the role activities and outdoor activities dimensions were at moderate levels. The core manifestations were mild restrictions in fulfilling family/social roles, outdoor travel, and participation in public activities, with daily social functions remaining relatively intact.

Group with severe limitations in social participation: A total of 84 cases, accounting for 22.82% of the total

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sample. Patients in this group had the lowest scores across all three dimensions, with conditional probabilities for each dimension all < 0.3. Severe limitations were present across all dimensions of social participation, rendering them virtually unable to fulfill social roles or participate in social and outdoor activities normally.

Results of the one-way ANOVA comparing the total scores and scores across dimensions of the Social Participation Scale among the three groups showed statistically significant differences between groups (F = 382.615–527.394, all P < 0.001). See Table 3 for details.

Table 3 Comparison of scores across dimensions of social participation among colorectal cancer patients with different underlying categories ($\bar{x} \pm s$, points)

Dimension	High Social Participation Group (n=118)	Partial Limitation Group (n=166)	Severe Limitation Group (n=84)	F value	P value
Role Activity	27.52±3.16	18.35±4.28	9.26±3.05	486.273	<0.001
Social Interaction	28.14±2.87	19.86±4.12	8.74±2.96	527.394	<0.001
Outdoor Activity	27.38±3.25	18.02±4.36	8.91±3.11	382.615	<0.001
Total Score	83.04±7.62	56.23±9.15	26.91±6.88	1126.582	<0.001

2.3 Results of Univariate Analysis for Different Latent Categories of Social Participation

2.3.1 Univariate Analysis of Categorical Data

Chi-square test results showed that there were statistically significant differences (P < 0.05) among patients in different latent categories of social participation in terms of age, educational level, marital status, employment status, monthly per capita household income, living arrangement, TNM staging, presence of a stoma, number of comorbid chronic diseases, and duration since diagnosis; However, there were no statistically significant differences between groups in terms of gender, health insurance type, tumor site, or treatment modality (P > 0.05). See Table 4 for details.

Table 4 Results of univariate analysis of categorical data for patients in different latent categories of social participation [n (%)]

Item	Category	High Social Participation Group (n=118)	Partial Social Participation Limitation Group (n=166)	Severe Social Participation Limitation Group (n=84)	χ^2 value	P value
Gender	Male	65(55.08)	96(57.83)	48(57.14)	0.231	0.891
	Female	53(44.92)	70(42.17)	36(42.86)		
Age group (years)	<60	56(47.46)	52(31.33)	13(15.48)	27.842	<0.001

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Item	Category	High Social Participation Group (n=118)	Partial Social Participation Limitation Group (n=166)	Severe Social Participation Limitation Group (n=84)	χ^2 value	P value
	60~74	54(45.76)	98(59.04)	34(40.48)		
	≥75	8(6.78)	16(9.64)	37(44.05)		
Marital status	Married	112(94.92)	149(89.76)	65(77.38)	15.627	<0.001
	Unmarried / Divorced / Widowed	6(5.08)	17(10.24)	19(22.62)		
Educational level	Primary school or below	12(10.17)	41(24.70)	34(40.48)	32.586	<0.001
	Junior high school	30(25.42)	42(25.30)	42(50.00)		
	Senior high school / Technical secondary school	38(32.20)	47(28.31)	11(13.10)		
	College or above	38(32.20)	36(21.69)	7(8.33)		
Occupational status	Employed	38(32.20)	30(18.07)	4(4.76)	23.105	<0.001
	Retired / Unemployed	80(67.80)	136(81.93)	80(95.24)		
Monthly per capita household income	<3000 yuan	18(15.25)	45(27.11)	39(46.43)	26.743	<0.001
	3000~5000 yuan	52(44.07)	78(46.99)	35(41.67)		
	>5000 yuan	48(40.68)	43(25.90)	10(11.90)		
Type of medical insurance	Urban-rural resident medical insurance	60(50.85)	92(55.42)	46(54.76)	0.684	0.710
	Urban employee medical insurance	56(47.46)	71(42.77)	35(41.67)		
	Others	2(1.69)	3(1.81)	3(3.57)		
Living arrangement	Living with family	114(96.61)	152(91.57)	66(78.57)	20.018	<0.001
	Living alone	4(3.39)	14(8.43)	18(21.43)		

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Item	Category	High Social Participation Group (n=118)	Partial Social Participation Limitation Group (n=166)	Severe Social Participation Limitation Group (n=84)	χ^2 value	P value
Primary tumor site	Colon	62(52.54)	86(51.81)	44(52.38)	0.019	0.990
	Rectum	56(47.46)	80(48.19)	40(47.62)		
TNM stage	Stage I	39(33.05)	32(19.28)	7(8.33)	22.376	<0.001
	Stage II	52(44.07)	68(40.96)	32(38.10)		
	Stage III	27(22.88)	66(39.76)	45(53.57)		
Ileostomy placement	No	101(85.59)	121(72.89)	34(40.48)	52.631	<0.001
	Yes	17(14.41)	45(27.11)	50(59.52)		
Number of comorbid chronic diseases	0	68(57.63)	62(37.35)	21(25.00)	26.047	<0.001
	1	38(32.20)	59(35.54)	35(41.67)		
	≥2					
Duration since diagnosis	<6m	22(18.64)	45(27.11)	31(36.90)	9.264	0.055
	6m ～ 2y	54(45.76)	82(49.40)	40(47.62)		
	>2y	42(35.59)	39(23.49)	13(15.48)		
Main treatment method	Surgery+adjuvant therapy	90(76.27)	131(78.92)	66(78.57)	0.312	0.855
	Surgery alone	19(16.10)	23(13.86)	10(11.90)		
	Non-surgical comprehensive therapy					

2.3.2 Univariate Analysis of Quantitative Data

The results of the univariate analysis of variance (ANOVA) showed that there were highly statistically significant differences between groups (all $P < 0.001$) in anxiety scores, depression scores, total social support scores, Barthel Index scores, and cancer-related fatigue scores among patients in different latent categories of social participation. Pairwise comparisons between groups revealed that, from the "good social participa-

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tion" group to the "severely restricted" group, patients' anxiety, depression, and cancer-related fatigue scores showed a significant upward trend, while total social support scores and Barthel Index scores showed a significant downward trend. See Table 5 for details.

Table 5 Results of univariate analysis of continuous variables for patients in different latent categories of social participation ($\bar{x}\pm s$, points)

Assessment Indicator	High Social Participation Group (n=118)	Partial Social Participation Limitation Group (n=166)	Severe Social Participation Limitation Group (n=84)	F value	P value
Anxiety Dimension Score	4.38±2.61	7.52±3.15	11.26±2.84	158.632	<0.001
Depression Dimension Score	3.95±2.58	7.03±3.02	10.87±3.11	142.579	<0.001
Total Score of Social Support Rating Scale	40.25±6.12	33.84±5.76	27.16±6.03	106.884	<0.001
Barthel Index	96.27±5.38	86.15±12.42	65.38±18.69	137.926	<0.001
Total Score of Cancer-related Fatigue Scale	2.36±1.28	4.51±1.57	6.82±1.64		

2.4 Results of Multivariate Analysis of Latent Categories of Social Participation Among Colorectal Cancer Patients

Using the "good social participation" group as the reference group (coding: 0 = good social participation group, 1 = partially restricted social participation group, 2 = severely restricted social participation group) as the dependent variable, and the variables with statistically significant differences in the univariate analysis as independent variables, we performed a multivariate unordered logistic regression analysis after standardizing the variables (see Table 6 for coding details).

Table 6: Explanation of Variable Coding for Multiclass Logistic Regression Analysis

Variable Type	Variable Name	Coding Instructions
Dependent Variable	Latent Classes of Social Participation	0=HighGroup,1=Partial Limitation Group, 2 = Severe Limitation Group
Independent Variables	Age	Continuous variable, included as original value
Marital Status	0=Unmarried/Divorced/ Widowed,1=Married	

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Variable Type	Variable Name	Coding Instructions
Educational Level	1 = Primary school or below, 2 = Junior high school, 3 = Senior high school/Technical secondary school,4=College or above (ordinal categorical variable, included as original value)	
TNM Stage	1 = Stage I, 2 = Stage II, 3 = Stage III (ordinal categorical variable, included as original value)	
Ileostomy Placement	0 = No, 1 = Yes	
Number of Comorbid Chronic Diseases	0 = 0, 1 = 1, 2 = ≥2 (ordinal categorical variable, included as original value)	
Anxiety Dimension Score	Continuous variable, included as original value	
Depression Dimension Score	Continuous variable, included as original value	
Total Score of Social Support Rating Scale	Continuous variable, included as original value	
Barthel Index	Continuous variable, included as original value	
Total Score of Cancer-related Fatigue Scale	Continuous variable, included as original value	

Regression analysis results showed that age, presence of a stoma, TNM stage, number of comorbid chronic conditions, anxiety score, total social support score, Barthel Index, and cancer-related fatigue score were independent factors associated with patients being classified into the group with limited social participation ($P < 0.05$); Age, presence of a stoma, TNM stage, number of comorbid chronic diseases, anxiety score, depression score, total social support score, Barthel Index, and cancer-related fatigue score were independent factors influencing the classification of colorectal cancer patients into the severely restricted social participation group ($P < 0.05$).

Specific results: Compared with the group with good social participation, patients who were older, had a stoma, were at a more advanced TNM stage, had more comorbid chronic diseases, higher anxiety levels, lower social support levels, poorer activities of daily living (ADL) ability, and more severe cancer-related fatigue had a higher risk of being classified into the partially restricted social participation group; Patients who were older, had a stoma, had a more advanced TNM stage, had more comorbid chronic diseases, had higher levels of anxiety and depression, had lower levels of social support, had poorer ADL ability, and had more severe

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cancer-related fatigue had a higher risk of being classified into the severely restricted social participation group. Detailed statistical results are shown in Table 7.

Table 7 Results of Multicategorical Logistic Regression Analysis on Factors Influencing Potential Categories of Social Participation in Colorectal Cancer Patients

Group 1: Good social participation; Group 2: Partially restricted social participation; Group 3: Severely restricted social participation

Independent Variable	2 vs 1					3 vs 1				
	β	SE	Wald χ^2	OR(95%CI)	P value	β	SE	Wald χ^2	OR(95%CI)	P value
Age	0.052	0.017	9.372	1.053(1.019~1.088)	0.002	0.118	0.022	28.786	1.125(1.078~1.174)	<0.001
Educational Level	-0.184	0.162	1.291	0.832(0.606~1.143)	0.256	-0.327	0.205	2.545	0.721(0.482~1.078)	0.111
Marital Status	-0.415	0.376	1.216	0.660(0.316~1.380)	0.270	-1.026	0.428	5.748	0.358(0.155~0.828)	0.017
TNM Stage	0.683	0.215	10.092	1.980(1.299~3.017)	0.001	1.357	0.264	26.396	3.885(2.312~6.529)	<0.001
Ileostomy Placement	0.854	0.318	7.216	2.349(1.260~4.381)	0.007	1.726	0.346	24.892	5.618(2.865~11.012)	<0.001
Number of Diseases	0.517	0.201	6.621	1.677(1.132~2.483)	0.010	0.882	0.242	13.274	2.415(1.501~3.887)	<0.001
Anxiety	0.218	0.057	14.632	1.244(1.112~1.391)	<0.001	0.305	0.076	16.093	1.357(1.169~1.575)	<0.001
Depression	0.106	0.059	3.228	1.112(0.990~1.249)	0.072	0.247	0.074	11.156	1.280(1.107~1.480)	0.001
Social Support	-0.087	0.026	11.217	0.917(0.871~0.965)	0.001	-0.152	0.033	21.206	0.859(0.805~0.917)	<0.001
Barthel Index	-0.062	0.015	17.095	0.940(0.913~0.968)	<0.001	-0.118	0.019	38.526	0.889(0.857~0.922)	<0.001
Fatigue	0.426	0.102	17.436	1.531(1.253~1.871)	<0.001	0.684	0.128	28.527	1.982(1.541~2.549)	<0.001

3. Discussion

Based on the ICF health framework and employing a person-centered latent class analysis approach, this study systematically examined the characteristics of heterogeneous subgroups regarding social participation among colorectal cancer patients. It further identified independent factors influencing subgroup membership, thereby addressing the limitations of previous variable-centered studies that struggled to accurately characterize patient population heterogeneity. This study provides an empirical basis for stratified and targeted interventions in the social functional rehabilitation of colorectal cancer patients.

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3.1 Latent Class Characteristics of Social Participation in Colorectal Cancer Patients

The results of this study indicate that social participation among colorectal cancer patients does not follow a uniform continuous distribution but exhibits significant population heterogeneity. The optimal fitting model classifies patients into three latent categories: the group with good social participation (32.07%), the group with partially restricted social participation (45.11%), and the group with severely restricted social participation (22.82%). The model's information entropy reached 0.892, indicating reliable classification results with clear clinical interpretability.

In terms of category distribution, over 60% of patients exhibit varying degrees of social participation limitations, with the partially limited group accounting for the highest proportion and representing the main population of colorectal cancer patients during the rehabilitation phase. The core characteristic of this group is that their social interaction functions remain relatively intact, but there are significant limitations in fulfilling family and social roles and participating in outdoor activities. This finding aligns closely with the clinical reality of cancer rehabilitation. Most colorectal cancer patients can maintain basic social interactions with family and friends after surgery; however, physical discomfort, bowel dysfunction, and decreased physical strength resulting from the disease make it difficult for them to return to their previous occupational roles, fulfill family responsibilities, or participate normally in outdoor public activities. This characteristic of "partial limitation" is difficult to accurately identify through traditional variable-centered analysis and suggests that clinical rehabilitation should not focus solely on patients' basic social skills but must also prioritize the restoration of their role-functioning and ability to engage in outdoor activities. Patients in the group with severely restricted social participation accounted for 22.82%. This group exhibited severe impairments across all dimensions of social participation, being almost completely detached from social interactions and public life; they represent a high-risk population requiring priority intervention in rehabilitation management. In contrast, patients in the group with good social participation maintained intact function across all dimensions and should be prioritized for functional maintenance in rehabilitation management.

Compared with similar studies both domestically and internationally, the distribution characteristics of the three categories identified in this study align with the rehabilitation trajectories of colorectal cancer patients, further validating the application value of latent class analysis in identifying functional heterogeneity among cancer patients. Previous studies on social participation in cancer patients have largely analyzed it as a continuous variable, yielding only group-level averages and failing to distinguish individual patients' patterns of limitation and core barriers. In contrast, this study, through subgroup classification, clearly delineates the core shortcomings in social participation among different patients, providing a clear, targeted direction for subsequent stratified interventions.

3.2 Factors Influencing the Potential Categories of Social Participation Among Colorectal Cancer Patients

The results of the multivariate analysis in this study indicate that multidimensional factors—including disease characteristics, physical function, psychological state, and social support—collectively influence the category of social participation among colorectal cancer patients. Furthermore, the influencing factors differ across subgroups with varying degrees of limitation, providing a basis for the selection of precise intervention

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targets.

3.2.1 Disease and Demographic Factors

This study found that age, the presence of a stoma, TNM staging, and the number of comorbid chronic conditions are common risk factors for limited social participation among colorectal cancer patients. The risk of restricted social participation increases with age. This is closely related to the natural decline in physical function among elderly patients, the gradual narrowing of their social circles with age, and the loss of social roles following retirement. Additionally, elderly patients have poorer tolerance for cancer treatment and experience longer-lasting treatment-related adverse effects, which further exacerbate barriers to their social participation.

A stoma is a key independent risk factor affecting patients' social participation; regardless of whether in the partially restricted or severely restricted groups, patients with a stoma had a significantly increased risk of restricted social participation. This finding is consistent with previous research. The changes in bowel habits, stoma-related complications, and the risk of odor and leakage associated with a stoma can lead to intense feelings of shame and self-denial in patients, causing them to actively avoid social settings and public activities. Additionally, the complexity of stoma care limits patients' outdoor mobility and extended outings, ultimately resulting in a significant reduction in the scope and depth of their social participation.

The risk of restricted social participation increases with more advanced tumor TNM staging and a higher number of comorbid chronic conditions. Patients with more advanced staging often require more aggressive anticancer treatments, experience more severe treatment-related adverse reactions, and suffer greater physical debilitation from the tumor itself, which directly diminishes their physical stamina and capacity for social engagement. Meanwhile, the presence of multiple comorbidities compounds physical functional impairments, increases the burden and risks associated with daily activities, and further restricts social participation.

3.2.2 Factors Related to Physical Function

Activities of Daily Living (ADL) ability (Barthel Index) and cancer-related fatigue are the core physical factors influencing patients' social participation categories. ADL ability serves as the foundation for social participation. The results of this study indicate that the lower a patient's Barthel Index, the higher the risk of restricted social participation, which is fully consistent with the core principle in the ICF framework that "activity capacity is a prerequisite for participation capacity." Postoperative bowel dysfunction, decreased physical fitness due to surgical trauma, and nerve damage in colorectal cancer patients all impair their ability to perform activities of daily living. When patients are unable to independently perform basic activities such as going out, personal hygiene, and using the restroom, participation in social activities becomes impossible.

Cancer-related fatigue is the most common treatment-related adverse reaction in colorectal cancer patients. This study found that the more severe the fatigue, the higher the risk of restricted social participation. Cancer-related fatigue is a persistent, subjective sense of exhaustion that cannot be alleviated by rest. It directly depletes the physical and mental energy required for social and outdoor activities. Additionally, the low mood associated with fatigue reduces patients' subjective willingness to participate in social activities, ultimately leading to their gradual withdrawal from social environments and exacerbating limitations in social participation.

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3.2.3 Psychological and Social Support Factors

Anxiety is a common risk factor for both the partially restricted group and the severely restricted group, whereas depression is an independent risk factor only for the severely restricted group; this difference has significant clinical implications. Anxiety is prevalent among colorectal cancer patients. Concerns about disease recurrence, excessive focus on physical symptoms, and fear of stoma leakage can lead patients to avoid unfamiliar social settings and public places, resulting in limitations in role-related activities and outdoor activities. This also constitutes the core psychological barrier for patients in the partially restricted group. The impact of depression is even more profound, leading to symptoms such as diminished interest, social avoidance, reduced self-worth, and behavioral withdrawal. This not only weakens patients' willingness to participate in social activities but also causes them to completely lose the motivation to actively integrate into society, ultimately resulting in comprehensive and severe limitations in social participation. This suggests that for patients with severely limited social participation, psychological intervention—particularly intervention targeting depression—must be a core component of rehabilitation plans.

Social support serves as a crucial protective factor for social participation among colorectal cancer patients. The results of this study indicate that higher levels of social support are associated with a lower risk of patients being classified into the group with restricted social participation. Adequate social support not only provides patients with material assistance and care support for social activities, thereby reducing practical barriers to mobility and social interaction, but also alleviates patients' feelings of stigma and negative emotions through emotional support, enhancing their confidence and courage to integrate into society. It is thus a vital resource for promoting patients' social participation.

3.3 Implications for Clinical Practice

The findings of this study provide clear practical guidance for the comprehensive rehabilitation management of colorectal cancer patients, with the core focus being the implementation of stratified, precision-targeted social functional rehabilitation interventions based on latent category characteristics.

First, social participation assessment should be integrated into the comprehensive rehabilitation management system for colorectal cancer patients. Clinical healthcare providers should use standardized scales to conduct dynamic assessments of social participation functions throughout the entire process—from diagnosis, through the postoperative period, adjuvant therapy, and follow-up—to identify high-risk patients with limited social participation at an early stage, thereby shifting away from the previous focus solely on tumor treatment and management of physical symptoms.

Second, implement stratified, targeted interventions based on latent categories. For the group with good social participation, focus on functional maintenance by conducting regular rehabilitation follow-ups and health guidance to promptly identify and address newly emerging physical or psychological issues, thereby preventing a decline in social participation; For the largest group—those with partial limitations in social participation—targeted interventions will focus on their core areas of limitation. For example, for patients with restricted role-related activities, we will assist them in rebuilding their family and social roles and develop a step-by-step plan for vocational reintegration. For those with outdoor activity limitations related to stoma care, we will strengthen training in stoma care skills and prevention of complications to alleviate patients'

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stigma and concerns about going out; For the group with severe limitations in social participation, a multidisciplinary team collaboration model is adopted. Priority is given to improving patients' physical functional impairments, managing cancer-related fatigue, and alleviating severe anxiety and depression. The approach begins by restoring patients' daily self-care abilities and willingness to actively participate, followed by gradually guiding them to engage in social and outdoor activities, thereby achieving a stepwise rehabilitation process from basic functional recovery to social participation.

Third, emphasize the comprehensive management of interventionable targets. For the interventionable factors identified in this study—such as stoma care, cancer-related fatigue, anxiety and depression, and social support—integrate multidisciplinary resources including stoma care specialists, rehabilitation therapists, psychotherapists, and medical social workers to provide patients with "physical-psychological - social" rehabilitation support. Simultaneously, we will engage patients' families and community resources to enhance support systems at the family and community levels, thereby creating a favorable environment for patients' social participation.

3.3 Implications for Clinical Practice

Based on the characteristics of latent categories and influencing factors, we propose targeted recommendations for clinical nursing and rehabilitation management. For example: Incorporating social participation assessments into the comprehensive rehabilitation follow-up system for colorectal cancer patients to identify high-risk patients early; developing stratified, precision intervention plans for different subgroups; prioritizing the resolution of core barriers such as physical function and psychological distress for the group with comprehensive social participation limitations; and implementing targeted role rehabilitation and social skills training for the group with partial limitations.

Extending rehabilitation support recommendations to the family, community, and societal levels to improve the comprehensive rehabilitation support system for colorectal cancer patients.

3.4 Study Limitations and Future Prospects

This study has certain limitations: First, as a single-center cross-sectional study, all participants were recruited from a specific tertiary teaching hospital, resulting in limited sample representativeness. The generalizability of the findings requires further validation. Additionally, the cross-sectional design can only explore associations between variables and cannot establish causal relationships. Second, data were collected using self-report questionnaires, which may introduce self-reporting bias; Finally, this study did not incorporate multidimensional influencing factors such as the community environment, the economic burden of medical care, and disease stigma, which may have limited the comprehensiveness of the results.

Future research could include multicenter, large-sample epidemiological surveys to further validate the potential distribution of social participation categories among colorectal cancer patients in China; conduct longitudinal cohort studies to track the dynamic changes in social participation categories from diagnosis through the long-term rehabilitation period, thereby identifying core influencing factors at different stages; Based on the high-risk subgroups and intervention targets identified in this study, precision rehabilitation intervention protocols tailored to patients in different potential categories should be developed and validated to effectively

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promote the restoration of social functioning and comprehensive rehabilitation among colorectal cancer patients.

4. Conclusions

The results of this study indicate that there is significant heterogeneity in social participation among colorectal cancer patients in China. Patients can be classified into three potential categories: the group with good social participation, the group with partially restricted social participation, and the group with severely restricted social participation. More than 60% of patients exhibit varying degrees of restricted social participation. Age, stoma presence, TNM staging, number of comorbid chronic diseases, anxiety, level of social support, activities of daily living (ADL) ability, and cancer-related fatigue are the primary factors influencing social participation limitations in patients, while depression is a specific risk factor for severe social participation limitations. Clinical healthcare providers should prioritize the assessment of social participation in colorectal cancer patients. Based on the characteristics and core influencing factors of different subgroups, they should develop stratified and precise rehabilitation intervention strategies, focusing on high-risk patients such as the elderly, those with stomas, advanced-stage tumors, multiple comorbidities, and significant negative emotions. Through multidisciplinary comprehensive interventions, they should promote the restoration of patients' social functioning and improve their long-term quality of life.

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