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Physical activity levels and influencing factors among colorectal cancer patients: A cross-sectional study

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Abstract

Background Numerous studies have reported that a majority of colorectal cancer patients in China have low levels of physical activity. Early identification of relevant factors is beneficial for formulating physical activity interventions. This study aimed to describe the status of physical activity in colorectal cancer patients and determine psychosocial predictors of low levels of physical activity.

Methods We conducted a cross-sectional survey of 230 hospitalized patients with colorectal cancer in a tertiary hospital in Hubei Province. The research utilized a self-designed general information questionnaire, International Physical Activity Questionnaire Short Form (IPAQ-SF), Social Support Rating Scale (SSRS), Brief Illness Perception Questionnaire (BIPQ), and Posttraumatic Growth Inventory (PTGI) as assessment tools. SPSS 25.0 was used for descriptive statistical analysis, Chi-squared test, Student's t-test, and binary logistic regression analysis.

Results The prevalence of low physical activity among colorectal cancer patients was 52.5%. Binary logistic regression analysis revealed that monthly per capita household income of 3000–5000 yuan (OR = 0.274, 95% CI: 0.080–0.942), monthly per capita household income > 5000 yuan (OR = 0.191, 95% CI: 0.037–0.992), duration of diagnosis between 7 and 12 months (OR = 0.132, 95% CI: 0.030–0.587), social support score (OR = 0.802, 95% CI: 0.679–0.947), illness perception score (OR = 1.136, 95% CI: 1.019–1.266), and posttraumatic growth scores (OR = 0.915, 95% CI: 0.847–0.989) were independent predictors of physical activity in colorectal cancer patients.

Conclusions Overall, colorectal cancer patients in China have low levels of physical activity. These findings may provide valuable insights for healthcare professionals to identify individuals with low levels of physical activity and to develop effective intervention strategies. In future clinical practice, healthcare providers can promote physical activity in colorectal cancer patients through interventions aimed at enhancing social interactions, improving proper knowledge and understanding of the disease, and fostering posttraumatic growth.

Keywords Colorectal cancer, Physical activity, Illness perception, Posttraumatic growth

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Introduction

Colorectal cancer (CRC) ranks as the third most prevalent malignancy globally [1]. There were 517,100 newly diagnosed cases in China in 2022, second only to lung cancer; and it caused 240,000 deaths, which represents approximately 27% of global colorectal cancer mortality [2]. With advances in diagnostic and treatment techniques, the 5-year survival rate for CRC patients has improved [3]. However, CRC patients continue to face a range of physical and psychosocial sequelae after diagnosis and treatment, such as fatigue, depression, and social withdrawal [4–6]. Physical activity is an important non-pharmacological intervention that helps counteract many physical and psychological adverse effects of cancer treatment while enhancing health-related quality of life [7].

Physical activity (PA) is defined as any bodily movement generated by the contraction of skeletal muscles, leading to the expenditure of energy [8]. It includes occupational activities, exercise, leisure activities, and household chores. Evidence suggests that PA can significantly alleviate fatigue, pain, and insomnia, while also improving negative emotions such as anxiety and depression [9, 10]. For long-term benefits, several studies have shown that PA can effectively reduce the risk of cancer recurrence and mortality, and improve overall survival [9, 11, 12]. The internationally recognized physical activity guidelines recommend that cancer survivors should engage in at least 150 min of PA per week [13]. However, previous studies have shown that CRC patients' participation in PA is not optimal. Packel and Kang's study found that only approximately 25% of CRC patients met the requirements set by the physical activity guidelines [14, 15]. The majority of studies reported that the prevalence of low levels of PA in CRC patients ranged from 45.80–78.02% [16–18]. Therefore, it is crucial to take measures to enhance PA levels among CRC patients.

Developing effective PA interventions requires a thorough understanding of the factors that influence PA in this population. Currently, there is a limited number of studies on the factors influencing PA in CRC patients, with most focusing on demographic characteristics, disease and treatment factors [18, 19]. Previous studies have identified that age, income, educational level, employment status, symptoms of discomfort, comorbidities, cancer stage, and functional status may influence PA participation among CRC patients [14, 15, 18, 20]. However, relatively little attention has been given to modifiable psychosocial determinants.

Social Cognitive Theory (SCT) advocates explaining human behavior and functioning through a "triadic interaction" among the subject, behavior, and environment [21]. According to this theory, cognitive, emotional, and other personal factors, along with environmental events, may influence the PA behavior of CRC patients [22]. Illness perception (IP), as a personal cognitive factor, refers to patients' cognitive appraisals, emotional reactions and understanding of their disease [23]. IP has been shown to be effective in predicting coping behaviors, exercise, and self-management in patients with chronic disease [24, 25]. Leclair et al. [26] found that individuals with a greater understanding of cancer and fewer perceived illness consequences exhibited stronger confidence and a sense of control in managing their health, which may contribute to higher PA levels. However, the relationship between IP and PA in CRC patients has not yet been reported. In addition, posttraumatic growth (PTG), as a psychological factor, refers to the positive psychological changes that patients experience while struggling with major traumatic events (e.g. cancer) [27]. PTG is often accompanied by a renewed reflection on the meaning of life and a greater appreciation for health, which may encourage the adoption of healthier lifestyles, including regular PA [28]. While PTG has been proven to promote PA in breast cancer patients [29], studies examining its impact on PA in CRC patients remain limited. Furthermore, social support, as a crucial environmental factor, has been shown in several studies to have a positive effect on PA [30]. Emotional, material, or informational support from family, friends, and the community can alleviate patients' psychological stress and finally promote adaptive behaviors (e.g. PA) [31]. However, the evidence regarding the relationship between social support and PA in CRC patients remains inconsistent [31, 32].

Therefore, this study aims to explore how social support (environmental factors), illness perceptions (cognitive factors), and posttraumatic growth (psychological factors) influence PA levels in CRC patients. By clarifying these relationships, the findings can provide a theoretical foundation and novel insights for designing more targeted PA interventions, ultimately improving PA levels and overall well-being among CRC patients.

Methods

Study design and participants

The study employed a descriptive cross-sectional design with a convenience sampling method to recruit CRC patients hospitalized in the oncology department of a tertiary hospital in Hubei province from November 2023 to May 2024. The inclusion criteria for patients were as follows: (a) a confirmed pathological diagnosis of colorectal cancer; (b) age 18 years or older; (c) ability to communicate in Chinese; and (d) willingness to participate in the study. Patients were excluded if they had severe cognitive dysfunction, limb impairments, or movement-restricting conditions such as osteoarthropathy.

The sample size for this study was determined using the formula ($n=[Z_{\alpha/2}{}^2\pi(1-\pi)]/\delta^2$) for a cross-sectional study

[33]. After reviewing previous studies on PA in CRC patients, we found that the incidence of low levels of PA ranged from 45.80–78.02% [14, 16–18]. Consequently, we established the overall incidence $\pi = 0.6$, $\alpha = 0.05$, $Z_{\alpha/2} = 1.96$, $\delta = 0.1$. Based on these parameters, we calculated the required sample size to be 93. Considering the 20% loss of follow-up rate, the estimated necessary sample size was at least 112 participants.

Measures

The general information questionnaire

Demographic characteristics (including age, gender, ethnicity, religious belief, family residence, marital status, education level, employment status, and monthly per capita household income, sleep quality), disease-related information (such as duration of diagnosis, cancer stage, distant metastasis, tumor resection, enterostomy, adjuvant therapy, number of chemotherapy cycles, complications) were collected.

International physical activity questionnaire short form (IPAQ-SF)

IPAQ-SF was developed by the International Working Group on Physical Activity Measurement and subsequently translated into Chinese in 2004 by Qu [34], demonstrating a retest reliability of 0.626 to 0.877. The questionnaire comprises seven items, with the first six items primarily assessing the frequency (d) and duration (min) of high, moderate, and walking physical activities, each assigned a metabolic equivalent (MET) value of 8.0, 4.0, and 3.3 respectively. The final item evaluates the amount of time spent sitting per day. The weekly PA level = MET assigned for the activity×daily activity time (min)×number of days of activity per week. Based on the derived total weekly energy expenditure, an individual's PA can be categorized as high, moderate, or low intensity [35]. The questionnaire demonstrated strong reliability and validity within the Chinese population, Cronbach's α was 0.827 [36].

Social support rating scale (SSRS)

The SSRS developed by Xiao [37] was utilized in this study to assess the social support levels of patients. The scale consists of 10 items and includes three dimensions: objective support, subjective support, and support utilization. Items 1–5 and 8–10 are evaluated using a 4-point Likert scale, ranging from 1(none at all) to 4 (very much). Items 6 and 7 are assessed based on multiple choice responses, a response of "no source" is scored as 0, while each identified source under "have a source" is assigned a score of 1. The total SSRS score ranges from 12 to 66, with higher scores indicating higher levels of social support among the patients. In the present study, Cronbach's α of this scale was 0.76.

Brief illness perception questionnaire (BIPQ)

In this study, the BIPQ developed by Broadbent et al. [38] was utilized to evaluate patients' cognitive and emotional responses to their illness. The scale comprises 3 dimensions with a total of 9 items, wherein items 1 to 5 are designated for assessing the cognitive dimension, items 6 and 8 for measuring the emotional dimension, and item 7 for evaluating understanding ability. Item 9 is an open-ended question on etiology. Each item (excluding item 9) was scored on a scale of 0 to 10 points, with reverse scoring applied to items 3, 4 and 7; resulting in a total score range of 0 to 80 points. A higher score indicates a more negative illness perception and greater severity of symptoms experienced by the individual. Cronbach's α of the scale in the present study was 0.77.

Posttraumatic growth inventory (PTGI)

The PTGI was initially developed by Tedeschi and Calhoun [39] and later adapted for the Chinese population by Wang in 2011 [40]. This scale comprises a total of 20 items across five dimensions: life perception, personal strength, new possibilities, relationship with others, and self-transformation. Each item uses a six-point Likert scale, ranging from "none at all" to "very much," with scores assigned consecutively from 0 to 5. The total score is between 0 and 100 points, with higher scores indicating greater levels of posttraumatic growth. The scores ≤ 30 were classified as a low level of posttraumatic growth, 31 to 65 as a medium level, and 66 to 100 as a high level. In this study, the Cronbach's α for this scale was 0.85.

Data collection

Trained researchers followed standardized guidelines to explain the basic concepts, purpose, and significance of the study to CRC patients. The researchers also guaranteed the confidentiality of patient data and assured their right to withdraw from the study at any time. Upon obtaining permission from the patients, they signed the informed consent form. Subsequently, participants were provided with paper questionnaires for completion, which were collected by the researchers on the spot.

Data analysis

The data was analyzed using SPSS 25.0, with frequency and component ratio used to describe the categorical variables, and the Chi-square test employed for group comparisons. The continuous variables conforming to normal distribution were presented as mean ± standard deviation, and group comparisons were conducted using a two-independent sample t-test. The continuous variables with non-normal distribution were described by the median and interquartile range (P25, P75). Binary logistic regression was utilized to analyze the predictors of PA in patients with CRC. Furthermore, we made collinear

diagnoses of social support, illness perception, and posttraumatic growth. A significance level of $P<0.05$ was regarded as statistically significant.

Ethical considerations

Approval was obtained from the clinical research ethics committee of the hospital where the study was conducted (Ethics number: TJ-IRB20230761). The study was performed in accordance with the Helsinki Declaration. Written consent was obtained from all study participants. The article was written following the STROBE checklist.

Results

A total of 230 CRC patients participated in this study. After excluding 9 incomplete questionnaires (with more than 20% unfilled content), 221 valid questionnaires were included in the analysis, yielding an effective response rate of 96.09%.

Characteristics of participants

The demographic and disease-related information of 221 patients is shown in Table 1. Among them, there were 130 males and 91 females. The ethnicity of 87.8% of the patients was Han, 57.9% lived in urban areas, and 46.2% had a monthly per capita household income of 3,000–5,000 yuan. Moreover, 79.6% were married, with the majority having a junior high school education (31.7%), and 44.3% reported poor sleep quality. Regarding disease-related data, 33.1% of patients were diagnosed within the last 3 months. The most common cancer stage was stage III (38.9%), 63.8% received chemotherapy, and 50.7% underwent more than 4 cycles. Most patients (72.9%) had tumor resection, while 20.4% had an enterostomy. Additionally, 63.3% of patients showed no signs of distant metastases, and 82.8% did not experience any complications.

The status of PA in patients with CRC

The median level of PA among CRC patients in this study was 596 (IQR: 426, 924) MET min/week, with a range of 165 to 2178 MET min/week. According to the PA classification criteria [35], 116 cases (52.5%) were categorized as having low PA levels, 93 cases (42.1%) as moderate, and 12 cases (5.4%) as high. Due to the limited representation of patients exhibiting high levels of PA, we divided PA levels into two cohorts: the low-level group ($n=116$) and the medium-high-level group ($n=105$).

The univariate analysis of potential predictors of PA in patients with CRC

The results of univariate analysis are presented in Table 2, indicating statistically significant differences in PA levels ($P<0.05$) among CRC patients with varying characteristics such as age, religious belief, family residence, education level, employment status, monthly per capita household income, sleep quality, duration of diagnosis, cancer stage, distant metastasis, tumor resection, adjuvant therapy, social support score, illness perception score, and posttraumatic growth score. No significant differences were found in the remaining factors.

Furthermore, we performed a multicollinearity diagnosis for continuous independent variables, including social support, illness perception, and posttraumatic growth. The results showed that the variance inflation factor (VIF) for all variables was <5, indicating no collinearity among the independent variables.

The binary logistic regression analysis of potential predictors of PA in patients with CRC

The variables that exhibited a statistically significant difference in the univariate analysis were included as independent variables in the binary logistic regression analysis. Six independent predictors were identified as influencing PA in CRC patients. A monthly per capita household income of 3,000–5,000 yuan (OR: 0.274, 95% CI: 0.080–0.942, $P<0.05$), a monthly per capita household income >5000 yuan (OR: 0.191, 95% CI: 0.037–0.992, $P<0.05$), a diagnosis duration of 7–12 months (OR: 0.132, 95% CI: 0.030–0.587, $P<0.05$), social support score (OR: 0.802, 95% CI: 0.679–0.947, $P<0.05$), and posttraumatic growth score (OR: 0.915, 95% CI: 0.847–0.989, $P<0.05$) showed a positively relationship with PA, which were protective factors. Conversely, the illness perception score (OR: 1.136, 95% CI: 1.019–1.266, $P<0.05$) was negatively associated with PA and was identified as a risk factor. The details of binary logistic regression are shown in Table 3.

Discussion

The status of PA in patients with CRC

Decreased PA is common in patients with CRC. In this study, 52.5% of patients exhibited low levels of PA, aligning with the findings of Krogsgaard and Song et al. [18, 41]. However, the prevalence of low PA in this study was lower than that reported by Liu and Zhou et al. on CRC patients [42, 43]. This difference may be attributed to the fact that 48.5% of patients included in our study were under the age of 50, indicating a younger average age compared to previous studies. Younger patients tend to have superior physical fitness and recover more swiftly from the side effects of surgery and adjuvant chemoradiotherapy. Additionally, it is crucial to note that Liu and Zhou's studies specifically focused on patients who had undergone enterostomy, which can lead to psychological reactions such as anxiety and irritability due to changes in defecation patterns and body image. This may create a sense of stigma in social interactions, resulting in a decline in enthusiasm for engaging in PA [42, 43].

Table 1 Characteristics of the participants ($n = 221$)

Variables/classification	Number of examples (*n*)	Composition ratio (%)
Age (Year)		
≤ 50	90	40.7
51–60	71	32.1
>60	60	27.1
Gender		
Male	130	58.8
Female	91	41.2
Ethnicity		
Han	194	87.8
Other	27	12.2
Religion belief		
Yes	42	19.0
No	179	81.0
Family residence		
Township	93	42.1
City	128	57.9
Education level		
Primary school or below	34	15.4
Junior high school	70	31.7
Senior high school	50	22.6
College degree or above	67	30.3
Marital status		
Unmarried/divorced/widowed	45	20.4
Married	176	79.6
Employment status		
Employed	66	29.9
Retired	48	21.7
Unemployed	107	48.4
Monthly per capita household income (Yuan)		
<3000	64	29.0
3000–5000	102	46.2
>5000	55	24.8
Sleep quality		
Perfect	32	14.5
General	91	41.2
Poor	98	44.3
Duration of diagnosis		
≤ 3 months	73	33.0
4–6 months	54	24.4
7–12 months	44	19.9
≥ 13months	50	22.6
Cancer stage		
Stage II	19	8.6
Stage III	86	38.9
Stage IV	81	36.7
Uncertain	35	15.8
Distant metastasis		
Yes	81	36.7
No	140	63.3
Tumor resection		
Yes	161	72.9
No	60	27.1

Table 1 (continued)

Variables/classification	Number of examples (*n*)	Composition ratio (%)
Enterostomy		
Yes	45	20.4
No	176	79.6
Adjuvant therapy		
None	5	2.3
Chemotherapy	141	63.8
Radiotherapy	6	2.7
Chemoradiotherapy	69	31.2
Number of chemotherapy cycles		
≤4 times	109	49.3
>4 times	112	50.7
Complication		
Yes	38	17.2
No	183	82.8

Influencing factors of PA in patients with CRC

This study identified several factors influencing PA levels among CRC patients, including monthly per capita household income, duration of diagnosis, social support, illness perception, and posttraumatic growth. Among them, factors such as monthly per capita household income and duration of diagnosis are relatively fixed and difficult to modify, which can help healthcare providers identify CRC patients with potentially low PA levels. In contrast, social support, illness perception, and posttraumatic growth are modifiable psychosocial factors that can be improved through targeted interventions. Therefore, this discussion primarily focused on these psychosocial determinants.

Social support

This study found that social support was an independent protective factor for PA in CRC patients. This finding was in line with previous studies indicating a positive correlation between social support and PA [30, 44]. This may be because social support provides information on expected behaviors and fulfills the need for social connection, thereby boosting CRC patients' motivation and confidence to engage in PA [31]. Ma's study on lung cancer patients suggested that social support did not have a significant direct effect on PA but rather enhanced it indirectly through the mediating effect of self-efficacy [30]. However, the mechanism of the effect of social support on PA in CRC patients remains unclear, and future research should further explore how social support interacts with other psychological factors (e.g. emotional regulation, illness perception) to influence PA participation. Additionally, healthcare providers should emphasize the establishment of social support networks for CRC patients. By creating online communities and organizing group exercise programs to facilitate disease and PA knowledge sharing and emotional support, ultimately improving PA participation.

Illness perception

In the current study, we observed that high illness perception was a contributing factor to low levels of PA in patients with CRC, consistent with previous findings. Lan and Gu's studies indicated that IP was negatively correlated with functional exercise adherence in breast and lung cancer patients [45, 46]. IP reflects the patient's subjective perception of the degree of threat posed by the disease. The high mortality rate and poor prognosis of cancer may undermine patients' confidence in treatment and develop negative illness perceptions, intensifying fears and concerns about disease outcomes, which ultimately diminish motivation to engage in PA [47]. Existing studies have found that coping and self-transcendence as mediating variables can buffer the negative effects of negative illness perceptions on health behavior [47, 48], and the specific mechanism of these variables between IP and PA in CRC patients can be explored in the future. We recommend that clinical providers assess the IP levels of CRC patients at admission to identify those with negative beliefs and tailor PA interventions accordingly. Moreover, disease knowledge education and cognitive behavioral therapy (CBT) can promote a better understanding of the disease, change negative beliefs, and help patients recognize the safety and benefits of PA [48].

Posttraumatic growth

This study revealed that CRC patients with low posttraumatic growth scores were more likely to engage in low levels of PA. This is similar to the findings of Hawkes and Evans et al. [27, 49], who reported a positive correlation between PA and PTG in cancer survivors. This may be because a cancer diagnosis is an immensely traumatic

Table 2 Univariate analysis of physical activity levels in colorectal cancer patients ($n = 221$)

Variables	Low Level Group ($n = 116$)	Moderate-high Level group ($n = 105$)	Statistics (X^2/t)	*P*
Age (Years)				
≤ 50	39(33.6%)	51(48.5%)	6.024	**0.049**
51–60	39(33.6%)	32(30.5%)		
>60	38(32.8%)	22(21.0%)		
Gender				
Male	66(56.9%)	64(61%)	0.374	0.541
Female	50(43.1%)	41(39%)		
Ethnicity				
Han	98(84.5%)	96(91.4%)	2.479	0.115
Other	18(15.5%)	9(8.6%)		
Religion belief				
Yes	16(13.8%)	26(24.8%)	4.308	**0.038**
No	100(86.2%)	79(75.2%)		
Family residence				
Township	67(57.8%)	26(24.8%)	24.62	**0.000**
City	49(42.2%)	79(75.2%)		
Education level				
Primary school or below	26(22.4%)	8(7.6%)	21.062	**0.000**
Junior high school	45(38.8%)	25(23.8%)		
Senior high school	20(17.2%)	30(28.6%)		
College degree or above	25(21.6%)	42(40%)		
Employment status				
Employed	19(16.4%)	47(44.8%)	27.192	**0.000**
Retired	23(19.8%)	25(23.8%)		
Unemployed	74(63.8%)	33(31.4%)		
Marital status				
Unmarried/divorced/widowed	25(21.6%)	20(19%)	0.213	0.644
Married	91(78.4%)	85(81%)		
Monthly per capita household income (Yuan)				
<3000	51(44%)	13(12.4%)	37.438	**0.000**
3000–5000	52(44.8%)	50(47.6%)		
>5000	13(11.2%)	42(40%)		
Sleep quality				
Perfect	3(2.6%)	29(27.6%)	66.836	**0.000**
General	33(28.4%)	58(55.2%)		
Poor	80(69.0%)	18(17.2%)		
Duration of diagnosis				
≤ 3 months	43(37.1%)	30(28.6%)	9.28	**0.026**
4–6 months	25(21.6%)	29(27.6%)		
7–12 months	16(13.8%)	28(26.7%)		
≥ 13months	32(27.6%)	18(17.1%)		
Cancer stage				
Stage II	5(4.3%)	14(13.3%)	27.383	**0.000**
Stage III	31(26.7%)	55(52.4%)		
Stage IV	57(49.1%)	24(22.9%)		
Uncertain	23(19.8%)	12(11.4%)		
Distant metastasis				
Yes	57(49.1%)	24(22.9%)	16.395	**0.000**
No	59(50.9%)	81(77.1%)		
Tumor resection				
Yes	78(67.2%)	83(79%)	3.884	**0.049**
No	38(32.8%)	22(21%)		
Enterostomy				

Table 2 (continued)

Variables	Low Level Group ($n=116$)	Moderate-high Level group ($n=105$)	Statistics (X^2/t)	*P*
Yes	20(17.2%)	25(23.8%)	1.466	0.226
No	96(82.8%)	80(76.2%)		
Adjuvant therapy				
None	1(0.9%)	4(3.8%)	9.503	**0.015**
Chemotherapy	75(64.7%)	66(62.9%)		
Radiotherapy	0(0.0%)	6(5.7%)		
Chemoradiotherapy	40(34.5%)	29(31.2%)		
Number of chemotherapy cycles				
≤4 times	61(52.6%)	48(45.7%)	1.041	0.308
>4 times	55(47.4%)	57(54.3%)		
Complication				
Yes	25(21.6%)	13(12.4%)	3.255	0.071
No	91(78.4%)	92(87.6%)		
Social support(x ± s)	34.61 ± 3.19	39.50 ± 4.20	9.681	**0.000**
Illness perception(x ± s)	46.32 ± 5.39	38.88 ± 5.05	-10.559	**0.000**
post-traumatic growth(x ± s)	50.96 ± 5.88	60.09 ± 7.63	9.884	**0.000**

event that triggers cognitive processes of reconstructing personal beliefs and reevaluating priorities [50]. Through reflection, patients come to recognize the value of life and health, making them more inclined to adopt a positive lifestyle, which helps to increase PA levels. Therefore, healthcare providers should implement psychological interventions and encourage expressive writing to help patients recognize the positive changes in their lives. Besides, healthcare providers should actively listen to patients' unmet needs, assist patients in managing negative emotions and provide emotional support, thereby promoting their PTG [29]. However, the mechanism underlying the effect of PTG on PA in CRC patients is unclear [51], and further research could explore the potential pathways that mediate this relationship.

Limitations

Several limitations of our study must be mentioned. Firstly, using a cross-sectional design limited the ability to establish causality, highlighting the need for future longitudinal studies to explore the long-term effects of social support, illness perception, and posttraumatic growth on PA in CRC patients. Secondly, this study relied solely on subjective self-reported scales to assess PA, lacking objective assessments such as pedometers or sports bracelets, which may introduce recall bias. Finally, due to time constraints, we focused exclusively on CRC patients from a tertiary hospital in Wuhan, Hubei, limiting the generalizability of our findings to patients from different regions, cultures, or countries.

Clinical implications

The results of this study highlighted the relationship between PA level and social support, illness perception, and posttraumatic growth in CRC patients. These findings provide a vital theoretical foundation and a novel perspective for medical teams to develop personalized PA intervention programs. Moving forward, potential pathways linking these variables to PA levels should be investigated to identify entry points and targets for precise interventions.

Conclusion

In this study of CRC patients, nearly half of the participants reported low levels of PA. In addition, our analysis revealed that PA was associated with monthly per capita household income, duration of diagnosis, social support, illness perception, and posttraumatic growth. These findings underscored the importance of considering psychological and social factors when implementing PA interventions for CRC patients. In clinical practice, healthcare professionals are encouraged to aid patients in establishing social support networks, delivering disease knowledge education, and conducting positive psychological cognitive interventions to develop effective PA intervention strategies.

Table 3 Binary logistic regression analysis of predictors of physical activity levels in colorectal cancer patients

Variables	B	SE	OR(95%CI)	*P*
Age (≤ 50 years)	Reference			
51–60	0.762	0.750	2.142(0.492–9.322)	0.310
>60	1.233	0.818	3.340(0.690-17.039)	0.132
Religion belief (Yes)	Reference			
No	0.402	0.653	1.495(0.416–5.372)	0.538
Family residence (Township)	Reference			
City	-0.757	0.603	0.469(0.144–1.530)	0.209
Education level (Primary school or below)	Reference			
Middle school	-0.441	0.73	0.643(0.154–2.692)	0.546
High school	-0.883	0.97	0.413(0.062–2.767)	0.362
College degree or above	0.711	1.038	2.035(0.266–15.570)	0.494
Employment status (Employed)	Reference			
Retired	-0.267	0.896	0.765(0.132–4.431)	0.765
Unemployed	-1.037	0.859	0.354(0.066–1.909)	0.227
Monthly per capita household income (<3000 yuan)	Reference			
3000–5000 yuan	-1.294	0.63	0.274(0.080–0.942)	**0.040**
>5000 yuan	-1.655	0.841	0.191(0.037–0.992)	**0.049**
Sleep quality (Perfect)	Reference			
General	-0.538	0.939	0.584(0.093–3.677)	0.567
Poor	0.905	0.968	2.472(0.371–16.478)	0.350
Duration of diagnosis (≤ 3 months)	Reference			
4–6 months	-0.884	0.576	0.413(0.134–1.278)	0.125
7–12 months	-2.025	0.762	0.132(0.030–0.587)	**0.008**
>12 months	-0.851	0.806	0.427(0.088–2.071)	0.291
Cancer stage (stage II)	Reference			
Stage III	-0.718	0.916	0.488(0.081–2.938)	0.433
Stage IV	0.093	1.115	1.098(0.123–9.765)	0.933
Distant metastasis (Yes)	Reference			
No	0.096	1.032	1.101(0.146–8.330)	0.926
Tumor resection (Yes)	Reference			
No	-0.101	0.604	0.904(0.277–2.954)	0.867
Adjuvant therapy (None)	Reference			
Chemotherapy	2.030	1.867	7.616(0.196-295.949)	0.277
Chemoradiotherapy	2.646	1.895	14.100(0.344-578.637)	0.163
Social support	-0.221	0.085	0.802(0.679–0.947)	**0.009**
Illness perception	-0.088	0.039	1.136(1.019–1.266)	**0.021**
post-traumatic growth	0.128	0.055	0.915(0.847–0.989)	**0.025**

Note: *B*: Beta coefficient; CI: confidence interval; SE: standard error; bold: Statistically significant differences

Abbreviations

CRC	Colorectal Cancer
PA	Physical activity
IP	Illness perception
PTG	Posttraumatic Growth
SCT	Social Cognitive Theory
SPSS	Statistical Package for the Social Sciences
OR	Odd Ratio
MET	Metabolic Equivalent
CI	Confidence interval
SE	Standard error
P25	25th Percentile
P75	75th Percentile
IPAQ-SF	International Physical Activity Questionnaire Short Form
SSRS	Social Support Rating Scale
BIPQ	Brief Illness Perception Questionnaire
PTGI	Posttraumatic Growth Inventory

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Author contributions
Yanlei Sheng and Lulong Hu made substantial contributions to the conception of the work and drafted the original manuscript. Yanlei Sheng, Fan Shen, Mo Xiong, Qin Huang, and Qingyi Li participated in data collection, analysis and revision of the original manuscript. All authors contributed to the interpretation of results and manuscript preparation. All authors read and approved the final version for publication and are accountable for all aspects of the work.

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Data availability
The data supporting the findings of this study are available from the corresponding author upon reasonable request. The data are not publicly available due to privacy or ethical restrictions.

Declarations

Ethics approval and consent to participate
All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethics. The research was examined and approved by the Ethics Committee of Tongji Hospital Affiliated with Tongji Medical College of Huazhong University of Science and Technology (Ethics number: TJ-IRB20230761). Informed consent was obtained from all individual participants included in the study.

Consent for publication
Not Applicable.

Competing interests
The authors declare no competing interests.

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