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Research Article

The Cognitive Appraisal Path of Physical Activity, Benefit Finding, and Cancer-Related Fatigue Among Patients With Colorectal Cancer in China: Mediation Model Analysis

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Background: It has been shown that physical activity (PA) improves health outcomes in patients with colorectal cancer. Some studies have explored a few correlates of PA separately. However, the specific factors underlying cognitive appraisals and their pathways remain unclear.
Objective: To investigate the relationship between benefit finding and PA among patients with colorectal cancer and examine the mediating role of cancer-related fatigue in this relationship.
Methods: A cross-sectional study was performed at the colorectal departments of a hospital in Guangzhou, China between November 2023 and May 2024. A total of 355 patients with colorectal cancer were included in the analysis. Data were collected using the International Physical Activity Questionnaire-Long Form, Benefit Finding Scale, and Cancer Fatigue Scale. Spearman's correlation and a structural equation model were used to analyze the data.
Results: Benefit finding directly ($\beta = 0.20$, $p < 0.001$, 95% confidence interval = 0.09–0.31) and indirectly ($\beta = 0.04$, $p = 0.030$, 95% confidence interval = 0.01–0.09) influenced PA through cancer-related fatigue. Moreover, cancer-related fatigue partially mediated the effect of benefit finding on PA.
Conclusions: Benefit finding and cancer-related fatigue directly and indirectly influenced PA among patients with colorectal cancer. Future health education and effective interventions should focus on helping patients actively cope with disease to concurrently increase benefit finding and reduce cancer-related fatigue.
Implications for Nursing: The findings provide new insights into PA in patients with colorectal cancer and suggest that developing positive strategies to increase benefit finding and reduce cancer-related fatigue can thereby improve PA.

Keywords: benefit finding; cancer-related fatigue; colorectal cancer; cross-sectional study; physical activity

Summary

- To the best of our knowledge, this is the first study that investigated the mediating role of cancer-related fatigue in the relationship between benefit finding and physical activity among patients with colorectal cancer in China.
- Clinical health education and interventions should focus on developing positive strategies to increase benefit finding and reduce cancer-related fatigue, thereby improving physical activity.

1. Introduction

Colorectal cancer (CRC) is the third most common type of cancer worldwide and the second leading cause of cancer-related death, accounting for approximately one-fifth of all cancer-related deaths [1]. In 2020, 1.93 million new cases of

CRC and 930,000 deaths were recorded worldwide [2]. In the past 30 years, the incidence and mortality of CRC in China have increased significantly. In addition, the mortality rate associated with CRC in China was 14.63/100,000 males and 11.29/100,000 females. This evidence indicates that CRC poses a major public health problem globally [3].

Numerous studies have shown that moderate physical activity (PA) has a positive impact on health outcomes in patients with CRC, reducing fatigue, pain, insomnia, constipation, intestinal obstruction, and even mortality [4–8]. PA was defined by the World Health Organization as any physical movement produced by skeletal muscle that requires energy expenditure [9]. The World Cancer Research Fund/American Institute for Cancer Research and American Cancer Society and Colorectal Cancer Survivorship Care Guidelines also suggested that patients with CRC should engage in at least 150 min/week of moderate-intensity PA or 75 min/week of vigorous-intensity PA [10–12].

Although substantial evidence indicated that moderate PA has numerous benefits for the prognosis of patients with CRC, its implementation status is suboptimal [10, 13]. In general, the levels of PA among patients with CRC remain low [10]. Findings from the Korean Nation Health and Nutrition Examination Survey (2008–2011) indicated that the average weekly PA of patients with CRC is only half of that recorded for noncancer patients and decreases significantly with disease progression [14]. Data of 168 patients with CRC in China showed that only 25.6% met the guideline recommendations for PA [13]. Li et al. [10] conducted a study in 282 patients with CRC in China and reported similar results. Moreover, patients with CRC usually tend to a sedentary lifestyle. A survey performed in the Netherlands involving 145 patients with CRC showed that patients spent 10.2 h/day in a sedentary state [15]. In China, a cross-sectional study found that only 7.5% of patients with CRC had sufficient PA and 32.2% patients with CRC were completely sedentary [16]. In addition, adults spending more than 8 h/day in a sedentary state were at increased risk of all-cause mortality by 20% [17]. However, sufficient PA can prolong survival and was associated with a 26% relative reduction in mortality among patients with CRC [18]. Therefore, further study on improving PA in such patients is crucial.

Multiple factors influence the level of PA. Cognitive adaptation theory can contribute to exploring predictors of PA. Psychological adjustment to illness revolves around three themes: working to improve one's self-esteem; attempting to regain control over events and over one's life more generally; and finding meaning in the experience and the ability to develop positive fantasies (i.e., optimism) [19]. When confronted with adverse events, individuals would actively seek for the meaning in the experience to facilitate psychological adjustment, which is termed "positive illusion" [19]. Benefit finding is a form of "positive illusion" that significantly helps cancer patients cope with disease and engage in PA.

Benefit finding refers to a cognitive and behavioral adaptation process in which an individual perceives personal, social, psychological, and spiritual benefits after a traumatic event, such as illness [20]. It has been demonstrated that benefit finding is an important determinant linked to the adoption and maintenance of PA among patients with stroke and cancer [20, 21]. A study involving 4252 patients with prostate cancer found a significant positive correlation between benefit finding and PA level, in which a higher level of PA is associated with a greater degree of benefit finding [20]. Notably, benefit finding is also considered a psychological determinant of PA in patients with CRC, and enhancing benefit finding can significantly improve patient compliance in performing PA [21, 22].

Previous study has shown that cancer-related fatigue could explain low PA among patients with CRC. Cancer-related fatigue has been described as a painful, persistent, subjective sense of physical, emotional, and/or cognitive fatigue or exhaustion associated with cancer or cancer treatment. This type of fatigue disrupts the daily life and PA of patients even more than pain and nausea [23]. In a survey of 1569 patients with cancer, more than 80% of participants reported that they had experienced cancer-related fatigue. Cancer-related fatigue was reported by more than 70% of patients with CRC and persisted in 39% of long-term CRC survivors [24, 25]. Persistent cancer-related fatigue could cause exhaustion in patients and reduce PA. Previous study found that cancer-related fatigue is a significant risk factor for PA, and a lower level of PA was associated with a higher degree of cancer-related fatigue in patients with breast cancer [26], lung cancer [27], and CRC [24].

Hence, benefit finding can positively influence PA, whereas cancer-related fatigue can negatively affect PA. However, previous evidence suggested that a lower degree of benefit finding exacerbated cancer-related fatigue and led to reduced PA. Therefore, theoretically, those three factors constitute a vicious circle, affecting the prognosis of patients with CRC. However, the exact relationship between benefit finding, cancer-related fatigue, and PA among patients with CRC remains unknown. Thus, the aim of this study was to investigate the relationship between benefit finding and PA among patients with CRC, and examine the mediating role of cancer-related fatigue in this relationship.

2. Methods

2.1. Study Design and Data Collection. This was an observational cross-sectional study conducted between November 2023 and May 2024 in the colorectal departments of a tertiary first-class hospital in Guangzhou, China. A total of 355 patients with CRC were recruited by convenience sampling. The inclusion criteria were as follows: (1) confirmation of CRC diagnosis based on clinical and pathological findings, (2) patient age 18 years or older, and (3) ability to communicate verbally. The exclusion criteria were as follows: (1) diagnosis of a psychiatric illness by a physician or active use of antipsychotic drugs; (2) patients currently in an active treatment period within 3 days after the surgery; (3) suffering from severe liver, kidney, and cardiovascular diseases, musculoskeletal system disease, or other exercise contraindications; and (4) participation in other concurrent PA health education studies or intervention studies after admission.

After obtaining approval from the study hospital, researchers conducted unified training to the investigators to standardize their language before data collection. The investigators screened patients through the medical record system and recruited participants who met the eligibility criteria. The investigators conducted a face-to-face interview with the participants to introduce the purpose and process of this study, and invited them to participate in the survey. All participants voluntarily took part in this study and signed written informed consent. The investigators used questionnaires to collect data on the day before discharge. Uniform instruction language was employed to instruct patients on completing the questionnaire. The questionnaires were filled out by the patients themselves and retrieved immediately upon completion on the spot. The researcher immediately checked the completed questionnaires. If errors or omissions were detected, the researcher reconfirmed with the patients and urged immediate corrections or additions.

The participants completed the questionnaires in the ward and returned them to investigators. The following questionnaires were used: (1) sociodemographic and disease-specific data, (2) the International Physical Activity Questionnaire-Long Form (IPAQ-LF), (3) the Benefit Finding Scale (BFS), and (4) the Cancer Fatigue Scale (CFS).

2.2. Sample Size. Sample size was calculated according to the requirements of the ordinal logistic regression analysis and structural equation model (SEM). The sample size should be minimally 15 to 20 times the number of independent variables based on the requirements for ordinal logistic regression analysis [28]. This study included 14 independent variables; thus, the sample size should be 210 to 280 cases. The *N:q* rule was used to calculate the sample size of SEM, and q was the number of free parameters included in the model [29]. The *N:q* ratio for each free parameter is 10–20 participants [29]. There were eight free parameters in this study; therefore, 80–160 participants were required. In conclusion, by considering a 15% nonrespondent rate, the final sample size was at least 248.

2.3. Measurements

2.3.1. Sociodemographic and Disease-Specific Data. The demographic and disease-related questionnaire was designed to investigate the sociodemographic and disease-specific characteristics of patients. It included 12 questions focusing on sex, age, education level, marital status, monthly household income, medical history, etc.

2.3.2. IPAQ-LF. The level of PA among the participants was measured using the IPAQ-LF. The IPAQ-LF was developed by International Consensus Group on Physical Activity Measurement in 2001 [30] and translated into Chinese by Qu et al. in 2004 [31]. This tool included five PA domains, namely, work-related PA, housework, transportation, leisure and sport PA, and the time spent sitting. The questionnaire has shown good validity and internal consistency (Cronbach's $\alpha = 0.927$) for measuring the type, frequency (days/week), and duration (time/day) of PA [31].

Metabolic equivalent (MET) was used to assess the intensity of PA. The MET factor represents the amount of oxygen used at rest, which is 3.5 mL of oxygen per kg body weight per min. According to IPAQ guidelines, PA intensity was divided into walking (travel from one place to another on foot, both at work and at home, and was used only for recreation, sport, exercise or leisure), moderate PA (e.g., weight-bearing, regular cycling, cleaning the yard, eight trigrams boxing, and shadowboxing), and vigorous PA (e.g., heavy lifting, digging, aerobics, or fast cycling); MET values of 3.3, 4.0, and 8.0 were assigned to these levels of PA intensity [32].

Energy consumption associated with each type of PA was calculated as follows: the MET value of this activity × daily activity time (min) × activity days/week. Total PA was the sum of energy consumption associated with the three levels of intensity. According to the MET value, the PA was categorized as low-intensity (< 600 MET-min/week), moderate-intensity (600–2999 MET-min/week), and vigorous-intensity (≥ 3000 MET-min/week) PA. The detailed methodology for calculating MET-min can be found on the IPAQ website [31]. In this study, recommendations of the American College of Sports Medicine were used to evaluate whether the PA status of patients with cancer was up to the standard (i.e., at least 150 min of moderate-intensity PA or 75 min of vigorous-intensity PA per week) [33]. In the present investigation, Cronbach's α of the scale was 0.62.

2.3.3. BFS. Benefit finding was measured using the BFS, which was developed by Antoni in 2001 [34]. In 2015, Liu et al. [35] revised the BFS with 22 items in six subcategories, including family relations, health behaviors, social relations, acceptance, personal growth, and world view. A 5-point Likert scale is used for responses, yielding total scores from 22 to 110; higher scores indicate the higher levels of benefit finding. The BFS has shown good validity and internal consistency (Cronbach's $\alpha = 0.95$) among patients with cancer [36]. In this study, Cronbach's α of this scale was 0.96.

2.3.4. CFS. Cancer-related fatigue was measured using the CFS, developed by Okuyama in 2000 [36]. It comprises 15 items and covers three subcategories, namely, affective fatigue (four items), cognitive fatigue (four items), and physical fatigue (seven items). A 5-point Likert scale is used for responses, yielding total scores from 0 to 60; higher scores indicate higher levels of cancer-related fatigue. Cancer-related fatigue was classified into three levels, namely, Mild Fatigue (0–19), Moderate Fatigue (20–40), and Severe Fatigue (41–60). The CFS among patients with cancer has demonstrated good validity and internal consistency (Cronbach's $\alpha = 0.90$) [37]. In this study, Cronbach's α of the scale was 0.87.

2.4. Ethical Considerations. This investigation conformed with the principles of the Declaration of Helsinki [38]. This study was approved by the manager of the participating

hospital. The patients were informed that participation was voluntary and provided written informed consent. Ethical approval was provided by the Sun Yat-sen University Cancer Center (approval number: B2024-067-01).

2.5. Statistical Analysis. A database of PA data was created with Microsoft Excel software to enter and manage the data. Data entry was done by the principal researcher, and the original questionnaire data after input were checked to ensure the accuracy of the data. Before data analysis, the data regarding PA were entered into SPSS 25.0 software. Data were analyzed using SPSS, Version 25.0 (IBM Corp., Armonk, NY, USA), and Mplus, Version 8.1 (Muth'en & Muth'en, Los Angeles, CA, USA). Firstly, descriptive statistics (e.g., frequencies, median, means, and standard deviations [SD]) were used to describe the sociodemographic and disease-specific characteristics of patients. Secondly, descriptive statistics (e.g., mean ± SD) were used to describe PA, benefit finding, and cancer-related fatigue. Thirdly, Spearman's correlation analysis was used to analyze the correlation among PA, benefit finding, and cancer-related fatigue. Finally, SEM was used to assess the mediating effect of cancer-related fatigue in the relationship between benefit finding and PA, and only the total scores of the relevant variables were used. Previous studies indicated that the comparative fit index and Tucker–Lewis index values above 0.90, the root mean square error of approximation values, and the standardized root mean square residual values lower than 0.08 were indicative of a good model. A total of 5000 bootstrap samples drawn from the dataset were used to test the indirect effects [29, 39]. The 95% confidence interval (CI) did not include zero indicated that the indirect effects were statistically significant [39]. p values < 0.05 indicate the statistically significant differences. The percentage of missing data for each variable was analyzed. Since there were no missing data, no methods for handling missing data were applied.

3. Results

3.1. Participant Characteristics. A total of 362 patients met the inclusion criteria, while seven patients were excluded due to refusal to participate in the study. Finally, a total of 355 patients completed data collection and were included in the data analysis (response rate: 98.1%).

The mean age of patients was 58.10 (±10.93) years. The majority of the patients were male (59.2%), middle-aged (52.4%), married (87.6%), and unemployed (70.1%). Most participants had medical insurance (97.7%). Approximately a quarter of the participants (22.0%) had a monthly household income of less than 2000 Chinese Yuan. Approximately half of the participants (50.1%) did not attend high school. More than half (55.8%) were diagnosed with rectal cancer, and nearly one-fifth (16.9%) had enterostomy. Approximately a quarter of the participants (22.0%) had lost 5 kg of weight in the last 6 months. In addition, 8.2% of the participants had a family history of intestinal polyps (Table 1).

3.2. Descriptive Statistics. Skewness and kurtosis were used to test normality. Except for PA, the scores of benefit finding and cancer-related fatigue conformed to normal distribution. The median of PA among patients with CRC was 4022.10 (±7505.27) MET-min/week, and only 41.4% of the patients reached the PA recommendations of the American College of Sports Medicine. Among the 355 participants, 18.3% ($n = 65$), 37.7% ($n = 134$), and 44.0% ($n = 156$) reported low-intensity, moderate-intensity, and vigorous-intensity PA.

As shown in Table 2, the mean benefit finding score was 69.61 (±16.85). Among the six dimensions, patients benefited the most in the health behaviors dimension and the least in the world view dimension. The mean cancer-related fatigue score was 19.18 (±8.48), and the worst scores were observed in the affective fatigue dimension. In addition, more than half of the patients with CRC (51.3%) had moderate fatigue.

3.3. Correlation Analysis. As shown in Table 3, higher levels of benefit finding were significantly positively correlated with PA ($r = 0.28$, $p < 0.01$). A greater degree of cancer-related fatigue was significantly negatively associated with PA ($r = -0.25$, $p < 0.01$). Additionally, higher levels of benefit finding were negatively correlated with cancer-related fatigue ($r = -0.30$, $p < 0.01$).

3.4. Ordinal Logistic Regression Analysis. The ordinal logistic regression analysis showed that a family history of intestinal polyps (odds ratio [OR] = 0.27, $p = 0.003$, 95%CI: −2.16–−0.43) and benefit finding (OR = 0.98, $p = 0.005$, 95%CI: −0.03–−0.01) markedly increased PA. However, higher levels of cancer-related fatigue (OR = 1.05, $p < 0.001$, 95%CI: 0.02–0.08) and weight loss in the last 6 months (OR = 1.07, $p = 0.005$, 95%CI: 0.21–1.19) markedly decreased PA (Table 4).

3.5. Mediation Analysis. PA data did not conform to the normal distribution and were logarithmically transformed prior to mediation analysis. Table 5 and Figure 1 both showed the model with standardized path coefficients, demonstrating an excellent fit (χ^2/degree of freedom = 2.729, $p < 0.001$; root mean square error of approximation = 0.070, 90%CI = 0.057–0.083, $p = 0.006$; comparative fit index- = 0.942, Tucker–Lewis index = 0.927, standardized root mean square residual = 0.077). In the final model, the relationship between benefit finding and cancer-related fatigue (Path a, $\beta = -0.24$, $p = 0.001$) and the association between cancer-related fatigue and PA (Path b, $\beta = -0.18$, $p = 0.003$) were statistically significant. The direct effect of benefit finding on PA was also statistically significant ($\beta = 0.20$, $p < 0.001$). Moreover, the mediating effect of cancer-related fatigue on the relationship between benefit finding and PA was statistically significant ($a \times b = 0.04$, $p = 0.030$, 95%CI: 0.01–0.09). The results indicated that benefit finding exerted an indirect effect on PA through cancer-related fatigue. This

Table 1: Participant characteristics and their association with physical activity among patients with colorectal cancer ($N = 355$).

Variables	Category	N (%)	Physical activity Mean rank (MET-min/week)	Z/H	p value	Levels of physical activity, n (%)			χ^2	p value
						High	Moderate	Low		
Sex	Male	210 (59.2)	178.28	−0.062	0.951	93 (59.6)	79 (59.0)	38 (58.5)	0.029	0.986
	Female	145 (40.8)	177.59			63 (40.4)	55 (41.0)	27 (41.5)		
Age (years)	26–59	186 (52.4)	193.38	−2.963	0.003**	95 (60.9)	63 (47.0)	28 (43.1)	8.339	0.015*
	60–86	169 (47.6)	161.07			61 (39.1)	71 (53.0)	37 (56.9)		
Education level	Elementary and below	86 (24.2)	159.16	4.506	0.212	29 (18.6)	37 (27.6)	20 (30.8)	8.038	0.235
	Middle school	92 (25.9)	178.15			37 (23.7)	37 (27.6)	18 (27.7)		
	High school	92 (25.9)	183.59			47 (30.1)	32 (23.9)	13 (20.0)		
	College graduate and above	85 (24.0)	190.85			43 (27.6)	28 (20.9)	14 (21.5)		
Employment status	Employment	106 (29.9)	186.00	−0.959	0.338	54 (34.6)	32 (23.9)	20 (30.8)	3.998	0.135
	Unemployment/retired	247 (70.1)	174.59			102 (65.4)	102 (76.1)	45 (69.2)		
Marital status	Married	311 (87.6)	180.79	−1.361	0.174	142 (91.0)	115 (85.8)	54 (83.1)	3.301	0.192
	Unmarried/widowed/divorced	44 (12.4)	158.30			14 (9.0)	19 (14.2)	11 (16.9)		

Table 1: Continued.

Variables	Category	N (%)	Physical activity Mean rank (MET-min/week)	Z/H	p value	Levels of physical activity, n (%)			χ^2	p value
						High	Moderate	Low		
Household income (CNY/month/person)	< 2000	78 (22.0)	180.15	1.350	0.717	35 (22.4)	28 (20.9)	15 (23.1)	4.918	0.554
	2000–4999	122 (34.4)	171.16			47 (30.1)	51 (38.1)	24 (36.9)		
	5000–7999	92 (25.9)	177.47			43 (27.6)	30 (22.4)	19 (29.2)		
	≥ 8000	63 (17.7)	189.36			31 (19.9)	25 (18.6)	7 (10.8)		
Medical insurance	Yes	347 (97.7)	178.03	−0.031	0.975	153 (98.1)	130 (97.0)	64 (98.5)	0.547[a]	0.761
	No	8 (2.3)	176.88			3 (1.9)	4 (3.0)	1 (1.5)		
BMI (kg/m^2)	Healthy (18.5–23.9)	190 (53.5)	175.42	−0.509	0.611	80 (51.3)	77 (57.5)	33 (50.8)	1.349	0.509
	Underweight (< 18.5) or overweight/Obese (≥ 24)	165 (46.5)	180.98			76 (48.7)	57 (42.5)	32 (49.2)		
Diagnosis	Rectal cancer	198 (55.8)	175.32	−0.553	0.580	84 (53.8)	81 (60.4)	33 (50.8)	2.082	0.353
	Colon cancer	157 (44.2)	181.39			72 (46.2)	53 (39.6)	32 (49.2)		
Enterostomy	Yes	60 (16.9)	162.27	−1.303	0.193	25 (16.0)	25 (18.7)	10 (15.4)	0.486	0.784
	No	295 (83.1)	181.20			131 (84.0)	109 (81.3)	55 (84.6)		
Weight loss[b]	Yes	78 (22.0)	143.65	−3.347	0.001**	22 (14.1)	32 (23.9)	24 (36.9)	14.395	0.001**
	No	277 (78.0)	187.67			134 (85.9)	102 (76.1)	41 (63.1)		
Family history of intestinal polyps	Yes	29 (8.2)	237.21	−3.242	0.001**	21 (13.5)	6 (4.5)	2 (3.1)	10.506	0.005**
	No	326 (91.8)	172.73			135 (86.5)	128 (95.5)	63 (96.9)		

Note: CNY, Chinese Yuan; MET, metabolic equivalent.
Abbreviation: BMI, body mass index.
[a]Fisher's exact probability method.
[b]Lost 5 kg of weight in the last 6 months.
*$p < 0.05$ (two-tailed).
**$p < 0.01$ (two-tailed).

Table 2: Characteristics of physical activity, benefit finding, and cancer-related fatigue ($N = 355$).

Variables	Possible range	Total score[a]	Minimum	Maximum	Item score[a]	Rank
Physical activity (MET-min/week)	—	4022.10 ± 7505.27	33	115584.00	—	—
Benefit finding	22–110	69.61 ± 16.85	22	10	3.16 ± 0.77	—
Health behaviors	3–15	10.57 ± 2.98	3	15	3.52 ± 0.99	1
Family relations	2–10	6.96 ± 1.88	2	10	3.48 ± 0.94	2
Social relations	3–15	9.46 ± 2.77	3	15	3.15 ± 0.92	3
Acceptance	3–15	9.32 ± 2.76	3	15	3.11 ± 0.92	4
Person growth	7–35	21.61 ± 6.12	7	35	3.09 ± 0.87	5
World view	4–20	11.70 ± 3.47	4	20	2.92 ± 0.87	6
Cancer-related fatigue	0–60	19.18 ± 8.48	0	39	1.28 ± 0.57	—
Affective fatigue	0–16	7.58 ± 3.14	0	16	1.90 ± 0.78	1
Cognitive fatigue	0–16	4.32 ± 2.77	0	11	1.08 ± 0.69	2
Physical fatigue	0–28	7.28 ± 4.63	0	20	1.04 ± 0.66	3

Note: MET, metabolic equivalent.
[a]Values are presented as the mean ± standard deviation.

mediating effect accounted for 16.7% of the total effect. In this model, having a history of intestinal polyps had a significant positive impact on PA ($\beta = 0.12$, $p < 0.01$); nevertheless, the paths from age and weight loss to PA were not significant. The all paths of PA in this model together explained 11.90% of the variance in PA.

4. Discussion

In this study, the median score of PA for patients with CRC was 4022.10 MET-min/week, which was suboptimal. Only 41.4% of patients with CRC reached the requirements stated in guidelines (i.e., at least 150 min of light to moderate PA/week). Moreover, 18.3% of patients with CRC had low-intensity PA, mainly including sedentary and walking. Our results revealed that 50.6% of patients with CRC reported insufficient PA, which was lower than a previous study conducted in Canada (71.6%) [10]. A study involving 168 patients with CRC in China showed that only 25.6% of patients with CRC reached the recommended level of PA [13]. This indicated that, despite improvements, the PA of patients with CRC can be further improved. Breedveld-Peters et al. [40] performed a study in 151 patients with CRC and found that patients reporting higher levels of fatigue were more likely to be dissatisfied with participation restrictions on everyday life and PA. Furthermore, some patients lacked PA-related knowledge and thought that they should be more sedentary as well as reduce PA to avoid symptom aggravation and unnecessary injury. Therefore, nurses should assist patients in establishing the correct concept regarding exercise and help them develop safe, personalized, and regular PA plans.

The results of this study indicate that benefit finding and cancer-related fatigue are important predictors of PA in patients with CRC. Benefit finding had a direct effect on cancer-related fatigue and PA, as well as an indirect effect on PA through cancer-related fatigue. Our analysis found a significant positive correlation between benefit finding and PA, indicating that a higher level of benefit finding can increase PA in patients with CRC. This association was also observed in studies of patients with multiple sclerosis and multiple primary cancers [41, 42]. Martin et al. [42] performed a qualitative study in 12 patients with multiple sclerosis and demonstrated that higher levels of benefit finding were linked to greater perseverance and optimism, a more positive attitude toward negative events, and a higher likelihood of participating in PA. In a cross-sectional study of 238 patients with multiple primary cancers, Belcher et al. [41] reported that benefit finding was positively related to health behaviors. In addition, they reported that benefit finding plays an important positive role in promoting PA. Patients with greater degrees of benefit finding tend to pay more attention to their own health and have a stronger sense of health responsibility. This may be because such patients can more effectively recover from negative events associated with the disease and actively participate in PA to promote physical health than those with a smaller degree of benefit finding. Therefore, it is crucial to help patients with CRC develop a positive attitude toward the disease. This would enable them to more effectively cope with their disease and strengthen benefit finding, in turn improving their level of PA.

The present study showed that more than half of the patients with CRC had moderate cancer-related fatigue; this finding is consistent with results obtained from previous studies [43–45]. Cancer-related fatigue is common in patients with CRC, markedly affecting their daily life and quality of life. In this investigation, cancer-related fatigue emerged as a significant impediment to PA in patients with CRC, in agreement with previous studies [13, 44]. Kang et al. [13] investigated the relationship between fatigue and PA among 168 patients with CRC. They found that fatigue was a major impediment to PA. Lecat et al. [44] conducted a cross-sectional study in 65 patients with multiple myeloma, and the data revealed that patients with higher levels of cancer-related fatigue were more likely to avoid participating in PA than those with lower levels of cancer-related fatigue. Indeed, the worst scores were noted in the affective fatigue dimension, indicating that these patients may be weak, stay in bed longer, have a poor social life, and have high emotional stress, leading to reduced willingness to participate in PA. However, our results and those of other studies demonstrated that most patients with CRC experience cancer-related fatigue, resulting in a negative impact on

Table 3: Bivariate correlations between variables in spearman correlation for physical activity, benefit finding, and cancer-related fatigue ($N = 355$).

Variables	Bivariate correlations		
	Physical activity	Benefit finding	Cancer-related fatigue
Physical activity	1		
Benefit finding	0.28**	1	
Cancer-related fatigue	−0.25**	−0.30**	1

**$p < 0.01$ (two-tailed).

Table 4: Ordinal logistic regression analysis for physical activity among patients with colorectal cancer ($N = 355$).

Variables	β	SE	Wald value	p value	OR	95%CI	
						Upper limit	Lower limit
Benefit finding	−0.02	0.01	7.19	0.005**	0.98	−0.03	−0.01
Cancer-related fatigue	0.05	0.01	13.74	< 0.001**	1.05	0.02	0.08
Age	0.02	0.01	3.06	0.080	1.02	−0.01	0.04
Family history of intestinal polyps							
No (reference group)	—	—	—	—	1	—	—
Yes	−1.30	0.44	8.59	0.003**	0.27	−2.16	−0.43
Weight loss							
No (reference group)	—	—	—	—	1	—	—
Yes	0.70	0.25	7.95	0.005**	1.07	0.21	1.19

Abbreviations: CI, confidence interval; OR, odds ratio; SE, standard error.
**$p < 0.01$ (two-tailed).

Table 5: Mediation analysis of benefit finding, cancer-related fatigue, and physical activity ($N = 355$).

	Path/effect	β (95%CI)	SE	p value
BF ⟶ CRF ⟶ PA	a (BF⟶CRF)	−0.24 (−037, −0.08)	0.07	0.001**
$R^2 = 0.119$	b (CRF⟶PA)	−0.18 (−0.29, −0.05)	0.06	0.003**
	c' (BF⟶PA)	0.20 (0.09, 0.31)	0.06	< 0.001**
	a × b	0.04 (0.01, 0.09)	0.02	0.030*
	c	0.24 (0.14, 0.35)	0.05	< 0.001**

Note: a, independent variable to the mediator; b, mediator to the dependent variable; c', direct effect of independent variable on the dependent variable; a × b, indirect/mediating effect of the independent variable on the dependent variable through the mediator; c, total effect. The standardized coefficients are reported.
Abbreviations: BF, benefit finding; CI, confidence interval; CRF, cancer-related fatigue; PA, physical activity; SE, standard error.
*$p < 0.05$ (two-tailed).
**$p < 0.01$ (two-tailed).

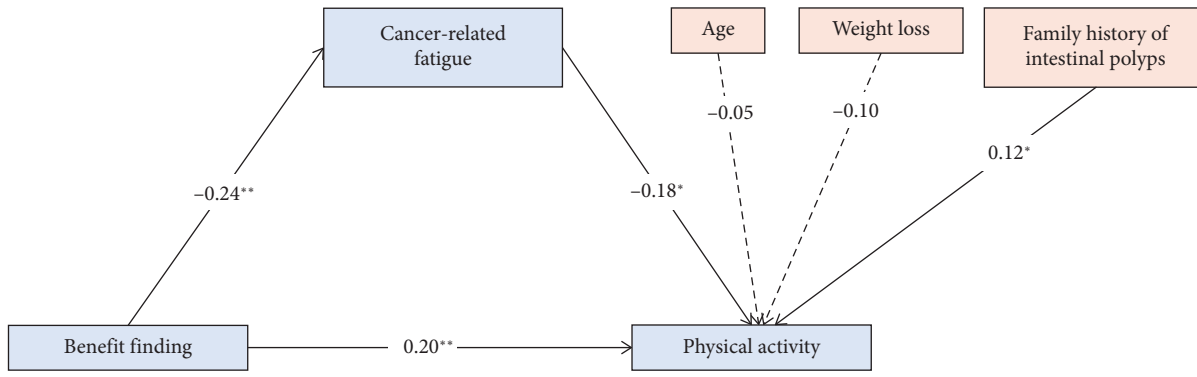

Figure 1: The mediating effect model of cancer-related fatigue on the relationship between benefit finding and physical activity. All the coefficients in the figure were standardized. *$p < 0.05$ (2-tailed), **$p < 0.01$ (2-tailed).

their PA. Therefore, nurses should evaluate the cancer-related fatigue status of patients with CRC and analyze the cause of cancer-related fatigue in a timely manner. The development of targeted interventions to decrease cancer-related fatigue may improve the PA status and mitigate adverse outcomes.

Our results revealed that cancer-related fatigue mediated the relationship between benefit finding and PA. Specifically, low levels of benefit finding increase the level of cancer-related fatigue, thus decreasing PA. In this study, more than half of patients with CRC had moderate fatigue, including affective, cognitive, and physical fatigue. Cancer-related fatigue aggravates the weakness, sedentary state, time spent in bed, and decreased physical function of patients and increases their negative perception of the disease. In this study, patients with CRC experienced marked affective fatigue, often feeling mentally exhausted, depressed, and tired of the disease. In addition, our results demonstrated that cancer-related fatigue is a negative factor affecting benefit finding. A greater degree of cancer-related fatigue leads to a stronger negative cognition of the disease, making it difficult for patients to acquire benefit finding. Therefore, all these manifestations of cancer-related fatigue may be related to a decline in benefit finding. This finding is consistent with the findings reported by Sheikh-Wu et al. [46]. A possible explanation is that greater degrees of cancer-related fatigue promoted a pessimistic attitude toward the disease, reduced benefit from the disease, and aggravated negative attitudes toward various health behaviors, thereby decreasing PA. Sheikh-Wu et al. [46] conducted a cross-sectional study in 117 patients with CRC and found that positive psychology (benefit finding and post-traumatic growth) partially mediates the relationship between symptoms (fatigue/feeling sluggish) and quality of life. This evidence indicated that patients with CRC should positively cope with their cancer and treatment, thereby decreasing their symptoms and improving their quality of life [47]. In this study, benefit finding directly contributed to increasing PA and indirectly increased PA via decreasing cancer-related fatigue. Therefore, our findings suggest that key measures to improve PA should simultaneously focus on improving benefit finding and reducing cancer-related fatigue in patients with CRC.

In our study, the direct relationship between a family history of intestinal polyps and PA was significant, indicating that this factor can directly positively affect PA. These findings are consistent with those reported by Li et al. [48]. Collectively, the data showed that patients with a family history of intestinal polyps may perceive themselves as more fragile and susceptible to disease; therefore, they actively engage in PA to prevent CRC. Brenner et al. [49] investigated 2496 individuals in Canada to assess the relationship between PA and the incidence of colorectal polyps. In accordance with the findings of this study, they found that increased PA is associated with a reduced incidence of colorectal polyps. A possible explanation was that patients with a family history of intestinal polyps are at a higher risk of developing CRC; hence, they tend to focus on preventing CRC. To reduce the risk of CRC, they actively take various measures to maintain physical health, including a healthy diet, good-quality sleep, weight loss, and regular PA. Consequently, future interventions for improving PA should focus on helping patients with a family history of intestinal polyps to establish a correct perspective on PA.

This was the first study to analyze the mediating effect of cancer-related fatigue on the relationship between benefit finding and PA in patients with CRC. Benefit finding and cancer-related fatigue were identified as potentially significant factors affecting PA, and cancer-related fatigue partially mediates the relationship between benefit finding and PA in patients with CRC. Therefore, interventions targeting benefit finding and cancer-related fatigue are crucial for improving PA levels among patients with CRC, thereby promoting their health and enhancing their overall quality of life.

4.1. Study Limitations. This study had several limitations that should be acknowledged. Firstly, the study employed a cross-sectional design; thus, causal inferences cannot be drawn. Secondly, Cronbach's α of the IPAQ-LF scale was only 0.62, indicating potential measurement error and limiting the generalizability of the findings. Future studies should adopt more accurate instruments to assess PA in patients with CRC. Thirdly, self-reporting questionnaires were used, possibly introducing a recall bias. Finally, convenience sampling was used, which may limit the generalizability of the findings.

5. Conclusions

In summary, our findings provide new insights into PA in patients with CRC and have important implications for future interventions to enhance PA. The data implied that increasing benefit finding and reducing cancer-related fatigue can directly and indirectly improve PA among patients with CRC. Therefore, future effective interventions should focus on helping patients change their negative attitudes toward the disease, thereby improving their benefit finding. Additionally, it is necessary to develop effective measures to maintain the physical and mental health of patients, thereby reducing cancer-related fatigue and then improving their PA. These findings emphasized that comprehensive intervention measures toward enhancing PA should consider improving benefit finding and decreasing cancer-related fatigue concurrently.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Disclosure

All authors read and approved the final manuscript.

Conflicts of Interest

The authors have no conflicts of interest to disclose.

Author Contributions

Xia Yang and Qun-Hong Liu were responsible for the study design. Qun-Hong Liu wrote the first drift of the manuscript, and Xia Yang revised the manuscript. Qun-Hong Liu, Li-Fang Yuan, Li-Ling Zhou, Li-Hao Ye, and Xia Yang participated in the data analysis and discussion. Qun-Hong Liu, Li-Fang Yuan, Li-Ling Zhou, and Li-Hao Ye participated in the data collection.

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