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Review Article

The Role of Multimodal Prehabilitation in Improving Postoperative Functional Outcomes in Colorectal Cancer Patients: A Review

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Abstract
Colorectal cancer is the third most common type of cancer worldwide and the second leading cause of death. Surgery remains the primary treatment modality, but the resulting surgical stress often triggers significant metabolic, cardiovascular, and psychological responses. Post-surgery, patients are at risk of a 20% to 40% decrease in functional capacity, leading to an increased risk of complications and prolonged hospital stay. This review aims to evaluate the benefits of a multimodal pre-rehabilitation program on improving post-operative functional and clinical outcomes in colorectal cancer patients. The methods of this article were searched through Scopus and PubMed databases for the period 2021-2026. Keywords used in the literature search included "prehabilitation" or "pre-habilitation," "colorectal cancer," and "functional outcome" or "6MWT." The results show that a multimodal pre-rehabilitation program integrating physical exercise, nutritional support, and psychological support (anxiety management and relaxation techniques) yields positive outcomes. The key efficacy parameter, 6MWT, demonstrated a highly significant increase in distance traveled compared to the control group, both pre-operatively (+96 meters) and at the 4- to 8-week post-operative evaluation. Furthermore, this intervention plays a role in reducing the incidence of major complications (Clavien-Dindo grade ≥ III) and has been shown in numerous studies to shorten hospital stays. The conclusion is that multimodal pre-rehabilitation is an effective perioperative preparation approach for colorectal cancer patients. This program consistently improves functional capacity, accelerates post-operative recovery, reduces the risk of serious complications, and shortens hospital stays, making it a standard strategy for improving patients' quality of life.
Keywords: colorectal cancer patients, functional outcomes, multimodal, prehabilitation, postoperative

INTRODUCTION

Colorectal cancer arises through a multistep process in which normal colonic mucosa gradually undergoes a series of precancerous changes before progressing to invasive malignancy. It is currently the third most frequently diagnosed cancer worldwide, accounting for approximately 1.9 million new cases and 935,000 deaths annually. Other reports have estimated the annual mortality associated with colorectal cancer to be around 600,000 deaths (Groen LC et al., 2024; Argilés et al., 2020). According to the American Cancer Society (ACS), colorectal cancer is the leading cause of cancer-related mortality among men younger than 50 years in the United States and the second leading cause among women in the same age group. The incidence of colorectal cancer has continued to rise, with an annual increase of 3% among individuals younger than 50 years between 2013 and 2022 and 0.4% among those aged 50–64 years. It is estimated that approximately 158,850 new cases of colorectal cancer and 55,000 deaths will occur in 2026 (Wolf AMD et al., 2026). Several modifiable risk factors have been implicated in the rising incidence of colorectal cancer, including excessive alcohol consumption, high intake of red meat, smoking, physical inactivity, environmental factors, antibiotic exposure, obesity, and metabolic syndrome, which may contribute to alterations in the gut microbiota. Although nearly 70% of patients with colorectal cancer are older than 65 years, an increasing incidence has also been observed among younger individuals, particularly those aged 40–44 years (Wolf AMD et al., 2026; Argilés et al., 2020). In response to this concerning trend, the American Cancer Society recommends initiating colorectal cancer screening at the age of 45 years.

Several therapeutic approaches are currently available for the management of colorectal cancer, including chemotherapy, immunotherapy, targeted therapy, radiotherapy, and surgical treatment. Despite advances in non-surgical therapies, surgery remains the cornerstone of curative treatment for most patients with colorectal cancer (Liao YS, 2025; Mao, 2025). However, postoperative complications are still frequently encountered and are particularly common among elderly patients, often resulting in impaired physical performance and longer hospital stays (Groen LC et al., 2024). Previous studies have shown that approximately 35% to 50% of patients undergoing colorectal resection develop postoperative complications (Liao YS et al., 2025; Gamage B et al., 2024).

Surgical procedures induce a physiological stress response that affects several body systems, including metabolic, cardiovascular, and psychological functions (Gao S, 2025). Older adults are especially susceptible to postoperative deterioration because recovery may be complicated by malnutrition, reduced mobility, and the presence of multiple comorbidities. In addition, delayed bowel function and loss of physical independence can lead to a reduction in physiological and functional capacity, which has been reported to reach 20–40% during the first 6–8 weeks after surgery. The severity of postoperative outcomes is influenced not only by the surgical procedure itself but also by preoperative factors such as nutritional status, psychological condition, smoking habits, and overall physiological reserve. Therefore, optimizing patients before surgery is essential to enhance recovery and improve perioperative outcomes in individuals with colorectal cancer (Pesce A et al., 2024; Liao YS et al., 2025; Gamage B et al., 2024). This narrative review is important for evaluating the benefits of a multimodal pre-rehabilitation program for improving postoperative functional and clinical outcomes in patients with colorectal cancer.

RESEARCH METHOD

Articles were reviewed to obtain data on the impact of prehabilitation on postoperative functional outcomes in colorectal cancer patients. Articles were collected using Scopus and PubMed databases from 2021-2026. Keywords used were "prehabilitation" OR "pre-habilitation" and "colorectal cancer" and "functional outcome" OR "6WMT". Scopus: 29 documents (all documents retrieved); PubMed: 23 documents (3 documents retrieved; 20 documents are the same as in the Scopus database).

Scopus is chosen for its high-quality data due to rigorous content selection and re-evaluation processes, extensive quality assurance, and its trustworthiness in large-scale analyses (Baas et al., 2020).

RESULTS

Multimodal Prehabilitation Approaches

For patients undergoing colorectal cancer surgery, the following multimodal prehabilitation approaches can be implemented:

1. Exercise Program

   Programs typically combine resistance training with home-based aerobic exercise. A standard session lasts approximately 50–60 minutes and begins with a 10-minute warm-up consisting of joint mobility and balance exercises. This is followed by 40 minutes of exercise focused on improving upper and lower limb muscle strength, as well as cardiorespiratory fitness. Resistance training for the upper limbs includes bicep curls, shoulder presses, and punches, whereas exercises targeting the lower limbs include squats, front lunges, lateral lunges, calf raises, and glute bridges. Core strengthening exercises, such as abdominal crunches and core stabilization exercises, are also commonly incorporated into training programs. Resistance exercises may be performed using body weight, elastic bands, dumbbells, exercise balls, or kettlebells to strengthen major muscle groups involved in daily functional activities. In most studies, resistance training is prescribed with 2–4 sets of 8–15 repetitions per exercise.

2. Aerobic Exercise Protocol

   Most studies recommend moderate-intensity aerobic exercise for 20–30 minutes, including walking, cycling, swimming, aerobic stepper exercises, or other cardiovascular training equipment. However, some studies have also incorporated higher-intensity aerobic activities, such as brisk walking. Exercise programs are generally performed three times per week for four weeks before surgery (Pesce et al., 2024; Maroto-Izquierdo et. al, 2025). During the prehabilitation period, several studies used accelerometers to monitor physical activity and patients' adherence to the exercise program. Cardiorespiratory function was assessed using Cardiopulmonary Exercise Testing (CPET). The test was performed on a treadmill at an initial speed of 2.4 km/h with a 1.5% incline, which was gradually increased according to the patient's tolerance. Before the test, patients were instructed to avoid food and beverages, except water, for at least two hours and to refrain from strenuous physical activity for the preceding two days. VO_2max was also measured (Pesce et. al, 2024). Patients can also perform a 30-minute home-based exercise session each day without direct supervision by following instructions provided on a pre-recorded Digital Video Disc (DVD). Each session consists of a 5-minute warm-up, 20 minutes of aerobic exercise, and a 5-minute cool-down (Gamage B et. al, 2024).

3. Nutrition Care

Nutritional care focuses on optimizing macronutrient intake and achieving a daily protein intake of approximately 1.5 g/kg of body weight. Patients' nutritional status, including body composition, caloric balance, and dietary intake, was assessed by a dietitian in accordance with the ESPEN Clinical Guidelines on Nutrition in Surgery (Pesce A et. al, 2024). Previous studies have also recommended a daily protein intake of 1.5–1.8 g/kg body weight, together with appropriate nutritional supplementation (Groen LC et al., 2024). Nutritional support may include 30 mg of whey protein administered one hour after exercise and one hour before bedtime, in addition to multivitamin supplementation (one effervescent tablet daily for two weeks), omega-3 fatty acids from fish oil (two effervescent tablets daily for two weeks), a high-protein diet, vitamin D, and calcium β-hydroxy-β-methylbutyrate (CaHMB). These nutritional supplements should be individualized to each patient's nutritional status and clinical condition (Pesce A et al., 2024; Molenaar et al., 2023; Triguero-Cánovas D et al., 2023). Patients are also encouraged to reduce smoking and alcohol consumption as part of the prehabilitation program.

4. Psychological Support

Patients' psychological status can be assessed using the Generalized Anxiety Disorder-7 (GAD-7) and Patient Health Questionnaire-9 (PHQ-9). Patients with a GAD-7 score of ≥10 or a PHQ-9 score of ≥15 receive a 90-minute psychological intervention during the first session. The initial 60 minutes focus on addressing anxiety, developing coping strategies, and preparing patients for postoperative recovery. During the remaining 30 minutes, patients are taught relaxation techniques and breathing exercises and are provided with written instructions to continue these exercises at home. Additional psychological support is also provided throughout the 4-week prehabilitation period (Pesce A et. al, 2024). Mindfulness exercises can also be incorporated into the prehabilitation program; a 12-week mindfulness intervention has been shown to reduce anxiety and depression (Gamage B et. al, 2024).

Clinical Outcomes of Prehabilitation

1. Functional Capacity (6MWT)

Patients' functional capacity was evaluated using the 6-Minute Walk Test (6MWT) at 4 and 8 weeks after surgery. During the test, patients walked back and forth along a 30-m walkway for six minutes, and the total distance covered was recorded (Pesce A et. al, 2024). According to Pesce et al. (2024), a 4-week multimodal prehabilitation program significantly improved the physical performance of patients. Zhang et al. (2024) demonstrated a significant improvement in postoperative functional capacity, as measured by the 6MWT, with a standardized mean difference (SMD) of 1.30 (95% CI 0.30–2.29). Patients who underwent prehabilitation achieved longer walking distances than the control group at all assessment time points. Before surgery, the mean walking distance was 96 meters greater in the prehabilitation group than in the control group (523 ± 24.6 vs. 427 ± 25.3; $p = 0.01$). This improvement was maintained at 4 weeks and 8 weeks after surgery, with between-group differences of 103 meters (514 ± 89 vs. 411 ± 115; $p = 0.003$) and 90 meters (531 ± 82 vs. 441 ± 107; $p = 0.008$), respectively. Similarly, Gao et al. found that the mean 6MWT distance increased by 59.03 meters before surgery (95% CI 6.85–111.21; $p = 0.03$), 43.01 meters at 4 weeks after surgery (95% CI 0.96–85.07; $p = 0.05$), and 26.93 meters at 8 weeks after surgery (95% CI 7.85–46.02; $p = 0.006$). In a study by Gillis

et al., patients who were able to walk at least 400 meters consistently reported better physical function ($P < 0.001$) than those who walked less than 400 meters (Gillis et. al, 2021).

2. Hospital Length of Stay (LOS)

   A systematic review conducted by Chang MC et. al (2023) found that patients who underwent a prehabilitation program had a shorter hospital length of stay than those in the control group, with an SMD ranging from −0.34 to −0.38. Gonella et al. reported that the prehabilitation group had a shorter median hospital length of stay of 4.5 days (range, 2–29 days) compared with 6 days (range, 2–56 days) in the control group. These results are consistent with those reported by Tai et. al (2026), in which the prehabilitation group had a median hospital stay of 7.91 days compared with 9.06 days in the control group. Conversely, Pesce A et al. (2024) found no significant difference in the length of hospital stay between the prehabilitation and control groups, with a median hospital stay of 4 days (IQR, 2–6) in both groups. Groen LC et al. also observed that the median hospital stay was 4.5 days in the prehabilitation group and 5.0 days in the control group, with no statistically significant difference ($p = 0.760$).

3. Postoperative Complications

   According to the study by Groen et al. (2024), a 3-week multimodal prehabilitation program for patients aged over 70 years reduced postoperative complications and resulted in no hospital readmissions within 90 days after surgery. In Tai R, et. al.'s study, of the 100 patients in the prehabilitation group, 11 experienced postoperative complications (6 with Clavien-Dindo grade I and 5 with grade II). Meanwhile, in the control group, 20 of 100 patients experienced complications (12 with grade I, 6 with grade II, and 2 with grade III). Major complications (grade ≥ III) were found only in the control group. The types of complications reported included chyle leakage, ileus, bleeding, and anastomotic fistula (Tai R et al., 2026). Furthermore, Gonella et al. found five cases of postoperative atrial fibrillation, five cases of pulmonary edema, and five cases of pneumonia exclusively in the control group, with none in the prehabilitation group. The incidence of postoperative ileus was also lower in the prehabilitation group than in the control group, with 2 and 17 cases, respectively (Gonella et al., 2024).

DISCUSSION

Rationale and Urgency of Prehabilitation

Surgery remains the primary treatment modality for colorectal cancer. Globally, approximately 9 million surgical procedures are performed annually, and the number of surgeries is projected to increase by 50% by 2040. Despite advances in surgical management, many patients experience new or worsening impairments after surgery, which may persist for several months. In addition, postoperative complications occur in approximately 35% of patients undergoing colorectal resection. Therefore, strategies aimed at reducing postoperative complications, facilitating recovery, and improving functional outcomes have become increasingly important in the management of patients with colorectal cancer (Molenaar et al., 2023; Liao YS et al., 2025).

The surgical procedure imposes additional demands on organ function, and the resulting surgical stress response contributes to postoperative complications. Therefore, prehabilitation may help improve patients' physiological reserve and functional capacity, ultimately supporting recovery after surgery (Liao YS et.al, 2025). Following the diagnosis of colorectal cancer, patients are commonly scheduled for elective surgery, making the preoperative period an ideal

opportunity to initiate prehabilitation interventions (Molenaar et. al, 2023). Prehabilitation is a multimodal strategy that combines physical exercise, nutritional interventions, and psychosocial support to enhance resilience and functional capacity before surgery, thereby helping patients better tolerate physiological stress and achieve optimal postoperative recovery (Vu J et al., 2023; Gamage B et al., 2024; Boyle et al., 2023).

Patients awaiting colorectal cancer surgery may experience fatigue, anxiety related to the recovery process and upcoming treatment, as well as symptoms of depression that can negatively affect their daily social and functional activities. Therefore, preoperative psychological support is needed to help reduce the emotional distress associated with surgery and postoperative recovery (Pesce A et. al, 2024; Gamage B et al., 2024). Psychosocial interventions, including mindfulness, can modulate the neuroendocrine response to surgery, thereby reducing the workload on the heart caused by emotional stress and potentially reducing inflammatory and stress hormone levels (Gamage B et. al, 2024; Gao S, 2025).

Interpretation of Functional Capacity and Recovery

The 6MWT is widely used to evaluate functional capacity and cardiorespiratory fitness, particularly in patients undergoing colorectal cancer surgery (Pesce A et al., 2024; Suarez-Alcazar et. al, 2025). The baseline ability of patients to perform physically before surgery has a major prognostic value; for instance, the inability to walk more than 400 meters before surgery has been associated with an increased risk of cardiovascular disease and future mortality among older adults (Gillis et. al, 2021).

The statistical gains observed in the reviewed literature suggest that prehabilitation contributes significantly to improved functional capacity following colorectal cancer surgery (Pesce A et. al, 2024; Gao S, 2025; Zahrenko et. al, 2023). These findings are consistent with criteria by Zahrenko et al. (2023), who established that successful prehabilitation is characterized by an increase in the 6MWT distance of more than 19 meters or an improvement of at least 30% from baseline. Collectively, these results indicate that the prehabilitation program not only improves functional capacity before surgery but also enhances postoperative recovery (Pesce A et. al, 2024; Gao S et. al, 2025).

Impact on Postoperative Complications and Hospital Stay

The majority of the available evidence suggests that prehabilitation enhances postoperative recovery in patients undergoing colorectal cancer surgery, thereby reducing the length of hospital stay. This is supported by multiple tracking metrics, including the Clavien-Dindo classification, which is widely used to assess the severity of complications ranging from mild grades to patient death (Widmar M et al., 2021). While some studies demonstrated that prehabilitation minimizes major complications (grade ≥ III) and common clinical issues like atrial fibrillation, pulmonary edema, pneumonia, and prolonged ileus (Tai R, et al., 2026; Gonella et al., 2024), the statistical significance of overall 30-day complications sometimes varies.

This variance extends to the hospital length of stay. While systematic reviews and targeted trials report a distinct reduction in hospital stay days for prehabilitation cohorts (Chang MC et. al, 2023; Gonella et al., 2024; Tai et. al, 2026), other prominent trials observed no statistically significant difference in hospital stay timelines between groups (Pesce A et al., 2024; Groen LC et al., 2024). The differences in these findings may be clinically attributed to several factors, including variations in baseline patient characteristics (such as age or frailty), the specific timelines and compliance of the prehabilitation protocols implemented, and institutional variations in perioperative surgical management.

CONCLUSION

Multimodal prehabilitation is a comprehensive approach to preparing patients for colorectal cancer surgery. This program has the potential to improve functional capacity, accelerate postoperative recovery, shorten the length of hospital stay, and reduce the incidence of postoperative complications, particularly major complications. Overall, multimodal prehabilitation, which integrates structured exercise, nutritional support, and psychological support, represents a promising strategy for improving perioperative outcomes in patients undergoing colorectal cancer surgery.

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AUTHOR CONTRIBUTIONS

Conceptualization, R.S. and Z.H.A.; Methodology, R.S. and W.M.S.; Data Curation, R.S., Z.H.A., and W.M.S.; Formal Analysis, R.S. and Z.H.A.; Investigation, R.S. and W.M.S.; Writing Original Draft Preparation, R.S., Z.H.A., and W.M.S.; Writing Review & Editing, R.S., Z.H.A., and W.M.S.; Visualization, Z.H.A. and W.M.S.; Supervision, W.M.S.; Project Administration, R.S. All authors have read and agreed to the published version of the manuscript.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

DECLARATION OF ARTIFICIAL INTELLIGENCE USE

This article used AI tools in the following capacities:

1. Manuscript writing support: AI-based language models, such as DeepL, ChatGPT, and QuillBot, were employed to refine the language (improving the grammar and sentence structure of the English text).

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