Mashhad University of Medical Sciences (MUMS)

Reviews in Clinical Medicine

Clinical Research Development Center Ghaem Hospital

Investigating Postoperative Nutritional Status In Patients With Colorectal Cancer: A Prospective Follow-up Study

Nafiseh Alizadeh[1], Abbas Abdollahi[2], Maryam Emadzadeh[3,4],Hossein Rahimi[5], Zohre Abdolahi[1], Mahsa Chaji[6], Fatemeh Shahabi[2], Sara Movahed [1,4*]

[1] *Department of Clinical Nutrition, Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran*
[2] *Endoscopic and Minimally Invasive Surgery research center, Mashhad University of Medical Sciences, Mashhad, Iran*
[3] *Clinical Research Development Unit, Ghaem Hospital, Mashhad University of Medical Sciences, Mashhad, Iran*
[4] *Metabolic Syndrome Research Center, Mashhad University of Medical Sciences, Mashhad, Iran*
[5] *Department of Internal Medicine, Devision of hematology, Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran*
[6] *Student Researcher Committee, Varastegan Institute of Medical Science, Mashhad, Iran*

ARTICLE INFO

Article type
Original article

Article history
Received: 01 Jan 2026
Accepted: 12 May 2026

Keywords
Malnutrition
Colorectal Cancer
Nutritional assessment
After Surgery
PG-SGA
Postoperative

ABSTRACT

Background: Malnutrition is common after colorectal cancer surgery and may persist beyond hospital discharge. This study aimed to assess postoperative nutritional status and nutrition-impact symptoms in patients with colorectal cancer at short term follow-up after discharge.

Methods: In this prospective observational follow-up study, adult patients with pathologically confirmed colorectal cancer who underwent tumor resection were assessed at 2 weeks and 1 month postoperatively in an outpatient surgical clinic in Mashhad, Iran, from October 2023 to March 2025. Nutritional status was evaluated using the Patient-Generated Subjective Global Assessment (PG-SGA). Dietary intake was assessed using 3-day 24-hour dietary recalls. Anthropometry and body composition (including fat-free mass and fat-free mass index) were recorded. Nutrition-impact symptoms were graded using CTCAE v5. Physical function was assessed using the Karnofsky Performance Status questionnaire and Handgrip strength.

Results: A total of 117 patients were included with mean age 57.55 ± 13.18 years and 55.6% were female. The mean PG-SGA score increased from 9.32±4.03 at 2 weeks to 10.41±3.50 at 1 month postoperatively ($p<0.001$). 43.6% of patients and 55.6% of patients required critical nutritional intervention (PG-SGA score ≥9) respectively ($p<0.001$). Body weight decreased from 65.49±14.70 to 62.80±14.40 kg and underweight (BMI <18.5 kg/m^2) rose from 14.5% to 21.2% ($p<0.001$). At 2 weeks, patients aged <65 years had higher PG-SGA scores than those aged ≥65 years (10.17±4.20 vs 8.95±3.89; $p=0.01$), with no significant difference at 1 month. Higher PG-SGA scores correlated inversely with BMI ($\rho=-0.40$, $p<0.001$), FFMI ($\rho=-0.432$, $p<0.001$), and total body water ($\rho=-0.264$, $p=0.003$).

Conclusion: malnutrition were highly prevalent and tended to worsen during the first postoperative month after colorectal cancer surgery. These findings support routine, repeated post-discharge nutritional assessment and timely nutrition care focused on symptom management and intake optimization during early recovery.

Please cite this paper as:
Nafiseh Alizadeh, Abbas Abdollahi, Maryam Emadzadeh,Hossein Rahimi, Zohre Abdolahi, Mahsa Chaji, Fatemeh Shahabi, Sara Movahed. Investigating Postoperative Nutritional Status In Patients With Colorectal Cancer: A Prospective Follow-up Study. *Reviews in Clinical Medicine*. 2026;13(2): 127-136

Introduction

Colorectal cancer (CRC) is among the most common malignancies worldwide and remains a leading cause of cancer related mortality. It is recognized as the third most frequently diagnosed cancer and the second leading cause of cancer death globally(1). In Iran, CRC has been reported as the third most

***Corresponding author**: Sara Movahed, Department of clinical Nutrition, Faculty of Medicine, Paradise Daneshghah, Azadi Square, Mashhad, Iran*
Email: MovahedS@mums.ac.ir

Doi: 10.22038/rcm.2026.94226.1581

common cancer since 2016 and is projected to remain among the most prevalent cancers, with an overall increasing trend in recent decades and a growing incidence in adults younger than 50 years(2, 3). These patterns underline the expanding clinical and public health burden of CRC and highlight the need to optimize supportive care strategies that may improve postoperative recovery and long term outcomes.

Malnutrition is a frequent and clinically significant complication across the cancer continuum. Evidence suggests that malnutrition is prevalent in patients with cancer and can particularly worsen after surgical treatment of CRC(4). In postoperative CRC populations, malnutrition rates up to 94% have been reported(4).

The mechanisms underlying cancer-related malnutrition are multifactorial and include reduced dietary intake, gastrointestinal symptoms, systemic inflammation, and metabolic alterations. Surgery itself represents an additional physiological stressor(5, 6). Major colorectal surgery is a highly invasive procedure that can trigger inflammatory responses and metabolic stress, which may further increase the risk or severity of postoperative malnutrition(7). These processes are especially relevant in gastrointestinal cancers, where nutritional reserves may already be compromised before treatment initiation.

The clinical consequences of malnutrition are substantial. Malnutrition in cancer patients has been linked with increased morbidity and mortality, prolonged hospitalization, higher healthcare expenditures, reduced quality of life, decreased survival, and diminished effectiveness and tolerance of oncologic treatments(6). Importantly, malnutrition may contribute to a meaningful proportion of deaths among cancer patients independent of the malignancy itself; estimates suggest that 10–20% of mortality in this population may be attributable to malnutrition rather than the tumor directly(8).

From a perioperative perspective, deteriorating nutritional status can increase vulnerability to postoperative complications and impair recovery trajectories, emphasizing the importance of timely assessment and targeted nutritional interventions(9).

In Iran, available research indicates that malnutrition is common among patients with cancer, particularly those with gastrointestinal malignancies(9, 10). Studies using patient centered tools such as the Patient-Generated Subjective Global Assessment (PG-SGA) have reported considerable prevalence of malnutrition. For example, an evaluation of 416 cancer patients in Tehran reported malnutrition in 53.1% of participants(11), and additional work has documented high rates of moderate-to-severe malnutrition in different oncology settings, with gastrointestinal cancers frequently showing the greatest burden(12).

However, despite the growing incidence of CRC and the recognized clinical impact of postoperative malnutrition, comprehensive evidence focusing specifically on nutritional status after colorectal surgery in Iranian patients has been limited, indicating a meaningful gap in the local literature. Furthermore, the early postoperative period represents a critical window in which nutritional decline may emerge or worsen, potentially influencing complications, functional capacity, and the patient's overall recovery experience.

Accordingly, the present study aimed to evaluate comprehensive nutritional status in patients with colorectal cancer at two clinically relevant time points, two weeks and one month after surgery, using the PG-SGA. In addition we assessed dietary intake adequacy, anthropometric and body-composition indicators, and the burden of nutrition-impact symptoms during early recovery. By focusing on the first postoperative month, this study seeks to provide evidence to inform post-discharge nutritional screening and timely supportive care planning for patients undergoing colorectal cancer surgery.

Method

Study design and setting

This prospective observational study was conducted, among patients with colorectal cancer who attended for postoperative follow-up the outpatient surgical clinic at educational tertiary referral Ghaem Hospital, Mashhad, Iran. Participants were assessed at two predefined time points: approximately 2 weeks and 1 month after surgery. Data collection was performed over an approximately 18-month period from October 2023 to March 2025. This study was approved by the Research Ethics Committee (code: IR.MUMS.MEDICAL.REC.1402.291) of Mashhad University of Medical Sciences (MUMS).

Participants and sampling

Patients were eligible for inclusion if they had a diagnosis of colorectal cancer confirmed by pathology and had been admitted for surgical tumor resection. Participants were recruited using purposive convenience sampling from those attending postoperative follow-up at the outpatient surgical clinic. Inclusion criteria were: (1) age ≥18 years; (2) pathology-confirmed colorectal cancer; (3) admission for surgical resection of the tumor; and (4) provision of written informed consent. Patients were not eligible if they were unable to respond to questionnaires or if they did not know their body weight 1 month prior to the assessment. Participants were excluded if <70% of questionnaire items were completed due to lack of cooperation, if they declined body composition assessment, or if they were admitted due to recurrence of malignancy. Enrollment was

conducted through face-to-face contact; the study procedures were explained verbally, and written informed consent was obtained prior to participation.

Data collection and measures

Demographic and clinical characteristics

The demographic information was obtained through interviews and medical notes. Demographic data included age, education, living place, marital status, occupation, food availability, self-reported income sufficiency, smoking, and opium addiction. The economic status was achieved based on the Payab et al. study . The questionnaire asked whether they owned any of the items, including handmade carpet, washing machine, dishwasher, side-by-side refrigerator, furniture, microwave, computer or laptop, personal cars, and personal homes. Owning 1 to 3 of the items was considered low economic status, 4 to 6 items indicated medium economic status, and 6 to 9 items represented high economic status (13).Economic status was assessed as it may influence dietary intake and access to nutrition support, which are relevant to the patients' nutritional status. Occupational categories were grouped based on standard national classifications. 'Employee' referred to individuals working in formal salaried positions; 'Self-employed' included those who worked independently without a fixed employer; 'Worker' referred primarily to manual laborers; 'Housewife', 'Retired', and 'Unemployed' were considered separate categories based on social status. Information related to the disease included the stage, time of diagnosis, previous treatments, and history of chemotherapy and radiation. Additionally, chemotherapy protocol and history of underlying diseases were recorded.

Nutritional assessment

A comprehensive nutritional assessment were performed using PG-SGA, dietary intake, anthropometry and body composition analysis and clinical evaluation(14). The PG-SGA questionnaire as the gold standard tool for nutritional assessment of cancer patients captures recent weight loss, dietary intake adequacy, nutrition-impact symptoms during the preceding two weeks which leads to reduced food intake, and physical function, combined with clinician assessment to generate a total score guiding nutrition intervention triage: 0–1: no immediate intervention; 2–3: education/symptom-based support; 4–8: dietitian-led intervention; and ≥9: urgent symptom management and nutrition intervention . Patients were also categorized into PG-SGA global ratings: well-nourished (A), moderately malnourished/suspected (B), and severely malnourished (C), based on weight loss history and functional/body composition changes(15).

Height was measured using a wall-mounted stadiometer (Seca 206, Germany). For patients unable to stand, height was estimated using ulna length. Weight was measured using a calibrated scale (Seca 510, Germany) with minimal clothing and no shoes(16). Body mass index (BMI) was calculated as weight/height^2. Mid-upper arm circumference (MUAC) was measured on the right arm using a non-stretch tape (Seca 201, Germany) at the midpoint between the acromion and olecranon. Percent weight loss was calculated using the standard formula: (previous weight − current weight)/previous weight ×100.

Body composition was assessed using bioelectrical impedance analysis (BIA) (Bodystat MDD1500, Germany), providing total body water, fat mass, and fat-free mass. Fat-free mass index (FFMI) was calculated as fat-free mass/height^2. Low muscle mass was defined as FFMI <17 kg/m^2 in men and FFMI <15 kg/m^2 in women(17). Dietary intake was obtained using a 3-day 24-hour dietary recall. Nutrient intake (energy and macro/micronutrients) was analyzed using Nutritionist IV software (NUT 4.0). Energy and protein requirement were evaluated according to ESPEN practical guideline targets: 30 kcal/kg/day and 1.5 g protein kg/day for malnourished patients, and energy of 25 kcal/kg/day and protein of 1.2 g/kg/day for non-malnourished patients(18). Malnutrition was categorized using Global Leadership Initiative on Malnutrition (GLIM) tool (17).

Nutrition-related clinical symptoms were assessed according to CTCAE v5 criteria (e.g., dysphagia, nausea/vomiting, constipation/diarrhea, mucositis, dysgeusia and fatigue)(19).

Physical function was assessed using the Karnofsky Performance Status questionnaire and handgrip strength(20). Handgrip strength was measured using a Constant dynamometer with the elbow flexed at 90°, three trials per hand, and the average recorded (kg)(20).

Statistical analysis

The sample size was calculated based on Wei et al.'s study(4) , in which the mean and standard deviation of the PG-SGA score were reported as 15 and 5, respectively, considering d=1 and alpha 0.05, the sample size was estimated to be 97 people using the formula (quantitative trait estimate in the population). Considering about 20% attrition, the final sample size was estimated to be 117 people.

Analyses were conducted using SPSS version 27 (IBM Corp., Armonk, NY, USA), with a two-sided significance level of $p < 0.05$. Normality was assessed using the Shapiro–Wilk test. Quantitative variables were summarized as mean ±Standard deviation or median (interquartile range [IQR]),

and qualitative variables as frequency and percentage. For comparisons between two independent groups, the independent t-test or Mann–Whitney U test was used, as appropriate. Comparisons across more than two groups were performed using one-way ANOVA or the Kruskal–Wallis test. Changes between the two postoperative assessments (2 weeks vs 1 month) were evaluated using the Wilcoxon signed-rank test. Correlations were assessed using Spearman's rank correlation coefficient or Pearson's correlation for normally distributed variables, where applicable.

Results

Participant characteristics

A total of 117 patients were included with mean age 57.55 ± 13.18 years; ranged 24–85, and 55.6% were female. Most participants lived in urban areas (84.6%). Rectal tumors were the most common primary site (53.0%). Adenocarcinoma was the predominant histopathology (82.1%), and stage II disease was most frequent (39.3%) (Tables 1 and 2).

Table 1. Sociodemographic and lifestyle characteristics (n=117)

Age (years)[a]	—	57.55 ± 13.18
Sex	Male	52 (44.4)
	Female	65 (55.6)
Education	Illiterate	36 (30.8)
	Below diploma	42 (35.9)
	Diploma	27 (23.1)
	undergraduate	10 (8.5)
	Postgraduate	2 (1.7)
Residence	Rural	18 (15.4)
	Urban	99 (84.6)
Marital status	Married	89 (76.1)
	Single	6 (5.1)
	Divorced	12 (10.3)
	Widowed	10 (8.5)
Socioeconomic status	Low	54 (46.2)
	Middle	42 (35.9)
	High	21 (17.9)
Smoking status	Non-smoker	93 (79.5)
	Current smoker	10 (8.5)
	Passive exposure	3 (2.6)
	Former smoker	11 (9.4)
Substance abuse	Non-user	92 (78.6)
	Current user	19 (16.2)
	Passive exposure	1 (0.9)
	Former user	5 (4.3)
Insurance	None	9 (7.7)
	Basic insurance	83 (70.9)
	Basic + supplementary insurance	25 (21.4)

a. Mean ± SD

Table 2. Clinical and tumor characteristics (n=117)

Variable	Category	n (%)
Time since diagnosis (months)		6.57 ± 4.31[a]
Self-awareness of cancer		85 (72.6)
Comorbidities	Diabetes	27 (23.1)
	Cardiovascular disease	13 (11.1)
	Hypertension	38 (32.5)
	Hyperlipidemia	25 (21.4)
	Liver disease	3 (2.6)
	Kidney disease	3 (2.6)
	Other cancers	3 (2.6)
Tumor location	Right colon	18 (15.4)
	Left colon	28 (23.9)
	Transverse colon	7 (6.0)
	Right and left colon	2 (1.7)
	Rectum	62 (53.0)
Histopathology	Adenocarcinoma	96 (82.1)
	Invasive adenocarcinoma	9 (7.7)
	Mucinous adenocarcinoma	5 (4.3)
	SCC[b]	4 (3.4)
	Lymphoma	1 (0.9)
	Other	2 (1.7)
Stage	0	17 (14.5)
	I	25 (21.4)
	II	46 (39.3)
	III	22 (18.8)

	IV	7 (6.0)
Metastasis		7 (6.0)
Metastasis site	Liver	5 (4.3)
	Peritoneum	2 (1.7)
Treatment type before surgery	None	44 (37.6)
	Chemotherapy	11 (9.4)
	Radiotherapy	4 (3.4)
	Chemoradiotherapy	21 (17.9)
	TNT[c]	29 (24.8)

a. Mean ± SD
b. Squamous Cell Carcinoma
c. Total Neoadjuvant Therapy

Nutritional assessment

The mean PG-SGA score increased from 9.32±4.03 at 2 weeks to 10.41±3.50 at 1 month postoperatively (p<0.001). 43.6% of patients at 2 weeks and 55.6% of patients at 1 month after surgical resection required critical nutritional intervention (PG-SGA score ≥9) (Table 3). 71.7% of patients and 83.0% had moderate to severe malnutrition (category B or C), respectively (Figure 1).

Mean body weight decreased from 65.49±14.70 kg to 62.80±14.40 kg at 1 month postoperatively. At 1 month, weight-loss categories shifted toward greater severity, and severe/very severe weight loss increased from 33.4% to 69.3% (p<0.001). However, the proportion of underweight patients (BMI <18.5 kg/m^2) increased from 14.5% at 2 weeks to 21.2% at 1 month (p<0.001). Reduced muscle mass was observed in 29.1% of patients at both 2 weeks and 1 month postoperatively . Handgrip strength remained comparable between assessments (19.42±8.39 vs 19.61±8.26 kg). Karnofsky performance status was predominantly 50–70 at both time points, increasing from 65.0% at 2 weeks to 78.6% at 1 month (Table 3).

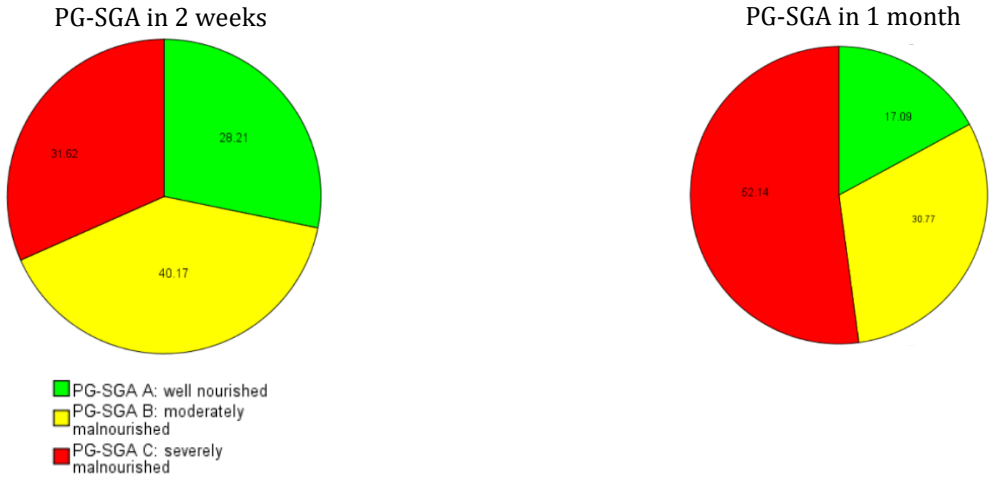

Fig1: Nutritional status based on PG-SGA category in 2 weeks and 1 month after surgical resection

Table3. PG-SGA score, anthropometric indices, body composition, physical performance of participants (n=117)

Variable	Mean ± SD OR N (percentage) 2 weeks	1 month	P-value
PG-SGA score	9/32±4/03	10/41±3/5	<0.001
0–1	0 (0.0)	0 (0.0)	
2–3	3 (2.6)	8 (6.8)	
4–8	58 (49.6)	49 (41.9)	
≥9	51 (43.6)	65 (55.6)	
BMI (kg/m2)	23.09 ± 5.22	23.03 ± 5.17	<0.001
<15	0 (0.0)	0 (0.0)	
15-15.9	0 (0.0)	2 (1.7)	
16-18.4	17 (14.5)	22 (18.8)	
18.5-24.9	54 (46.2)	56 (47.9)	
25-29.9	30 (25.6)	22 (18.8)	
≥30	16 (13.7)	15 (12.8)	

Weight loss[a]			<0.001
No WL	18(33.3)	10(8.5)	
Mild WL	7(13)	7(6)	
Moderate WL	11(20.4)	19(16.2)	
Severe WL	11(20.4)	58(49.6)	
Very severe WL	7(13)	23(19.7)	
MUAC (cm)	25.5±4.1	22.3±3.4	<0.001
Fat mass (%)	17.87±9.06	17.18±9.97	>0.001
FFMI (Kg/m2)	17.29±2.80	16.81±2.84	>0.001
Reduced muscle mass [b]	34(29.1)	34(29.1)	>0.001
Handgrip strength (Kg)	19.42±8.39	19.61±8.26	>0.001
Muscle strength [c]			>0.001
Weak	51(43.6)	65(55.6)	
Normal	18(33.3)	10(8.5)	
Strong	7(13)	7(6)	
Karnofsky[d]	70 (70-80) [e]	70 (70-90) [e]	>0.001
0-40	0	0	
50-70	76 (65)	92 (78.6)	
80-100	41 (35)	25 (21.4)	
Total energy intake [f]**:**			>0.001
(kcal/day)	1320 ± 509.9	1250 ± 54.9	
(g/kg/day)	22±13.1	20±11.5	
Protein intake[f] **:**			>0.001
(g/day)	50.6 ± 28.1	48.6 ± 25.3	
(g/kg/day)	0.77 ± 0.59	0.74 ± 0.45	

Abbreviations: SD, standard deviation; WL, weight loss; FFMI, fat-free mass index; MuAC, Mid upper-Arm Circumference; BMI, body mass index; PG-SGA, Patient-Generated Subjective Global Assessment

[a] No WL, <2% of body weight; 2-3% in 1-month or 2-6% in 6 months Mild WL, 3-5% in 1-month or 6-10% in 6 months Moderate WL, 5-10% in 1-month or10- 20% in 6 months Severe WL, >10% in 1-month or >20% in 6 months Very severe WL

[b] Reduced muscle mass was defined as FFMI<17 in men and FFMI<15 in women

[c] According to age and sex.

[d] 0-40 (Unable to care for self), 50-70 (able to live at home and care for most needs), 80-100 (no special care needed)

[e] Median (25th -75th percentile)

[f] Energy requirements are calculated based on current weight in malnourished individuals as 30 kcal/kg/day and 25 kcal/kg/day in non-malnourished individuals. Protein requirements are calculated based on current weight in malnourished individuals as 1.5 g/kg/day and 1.2 g/kg/day in non-malnourished individuals.

Dietary intake

Mean daily energy intake was 1320±509.9 kcal/day at 2 weeks and 1250±54.9 kcal/day at 1 month. At 2 weeks, 21.36% of patients consumed <50% of estimated energy needs, 26.49% consumed 50–80%, and 52.15% consumed >80%; at 1 month, the corresponding proportions were 23.09%, 32.47%, and 44.44%, respectively. Mean protein intake was 50.6±28.1 g/day at 2 weeks and 48.6±25.3 g/day at 1 month. At 2 weeks, ۸۰% and at 1 month 85% were classified as having inadequate protein intake (Table 3).

Nutrition-impact symptoms

Nutrition-impact symptoms were common at both follow-ups. Two weeks after surgery, almost all patients reported abdominal pain (99.1%); by 1 month, abdominal pain remained frequent (85.5%) despite painkiller intake. Anorexia was reported by 82.1% at 2 weeks and 68.4% at 1 month. Nausea decreased from 47.9% to 30.8%, and vomiting decreased from 14.5% to 3.4%. Fatigue remained highly prevalent (94.9%) at both time points (Table 4).

Table 4. Prevalence of nutrition-impact symptoms (any grade), n (%)

Symptom	2 weeks	1 month
Dysphagia	7 (6.0)	8 (6.8)
Abdominal pain	116 (99.1)	100 (85.5)
Anorexia	96 (82.1)	80 (68.4)
Nausea	56 (47.9)	36 (30.8)
Vomiting	17 (14.5)	4 (3.4)
Constipation	28 (23.9)	16 (13.7)
Diarrhea	14 (12.0)	1 (0.9)
Dysgeusia	30 (25.6)	11 (9.4)
Fatigue	111 (94.9)	111 (94.9)
Malaise	97 (82.9)	97 (82.9)

Factors associated with nutritional status

PG-SGA scores did not differ significantly by sex at either assessment (2 weeks p=0.67; 1 month p=0.33). At 2 weeks. Patients aged <65 years had higher PG-SGA scores compared with those aged ≥65 years (10.17±4.20 vs 8.95±3.89; p=0.01); this difference was not statistically significant at 1 month (11.57±3.80 vs 9.91±3.54; p=0.17).

Higher PG-SGA scores were associated with lower BMI (ρ=-0.40, p<0.001) and lower FFMI (ρ=-0.432, p<0.001), and were inversely correlated with total body water (ρ=-0.264, p=0.003) (Table 5).

Table 5. Spearman correlations with PG-SGA

BMI (kg/m²)	-0.40	<0.001
FM (%)	0.030	0.752
FFMI (kg/m²)	-0.432	<0.001
Total body water (L)	-0.264	0.003
Number of chemotherapy sessions	-0.37	0.784
Disease duration	-0.189	0.067

[a] Spearman correlation analyses

Discussion

In this study, a total of 117 colorectal cancer patients were evaluated at two clinically relevant postoperative time points (2 weeks and 1 month after surgery). The mean PG-SGA score increased from 9.32±4.03 at 2 weeks to 10.41±3.50 at 1 month postoperatively (p<0.001). Based on the PG-SGA global rating, 71.7% of patients at 2 weeks and 83.0% at 1 month were classified as moderately to severely malnourished (category B/C). suggesting worsening nutritional status over the first postoperative month and supporting the need for repeated screening and timely nutrition care.

PG-SGA scores ≥9, indicating a need for critical nutrition intervention, were observed in 43.6% of patients at 2 weeks and 55.6% at 1 month after surgery which means the more patients needed a serious nutritional interventions after 1 month. Consistent with these findings, according to the PG-SGA score, Wei et al. reported 94% postoperative malnutrition in colorectal cancer (4), and Karin et al. found that 48% of patients required nutritional intervention after surgery(21). Taken together, these data alongside our findings reinforce the clinical importance of systematic nutritional assessment and prompt, individualized nutrition care in the postoperative setting.

Postoperative weight loss was common and became more frequent with time; 66% of patients reported weight loss at 2 weeks, increasing to 91% at 1 month (p<0.001), indicating a significant worsening during early recovery.

Mean BMI was similar at 2 weeks and 1 month after surgery (23.09 vs 23.03 kg/m²), although the proportion of underweight patients increased from 14.5% to 20.5%, while most remained in the normal BMI range. This is broadly consistent with Barro et al. and Nunes et al., who also reported relatively low underweight prevalence and a high proportion of normal BMI(22, 23). Despite this, malnutrition was common in our cohort, indicating that BMI alone may underestimate nutritional risk in colorectal cancer. Consistent with Wang et al., we observed significant inverse associations between BMI and FFMI and PG-SGA, suggesting that lower BMI and FFMI are linked to worse nutritional status and supporting the use of comprehensive assessment tools alongside anthropometry(24).

In the present study, postoperative dietary intake was suboptimal and worsened from 2 weeks to 1 month after surgery. Mean energy intake was low at both assessments (1320±509.9 kcal/day at 2 weeks and 1250±54.9 kcal/day at 1 month), and the distribution of energy adequacy shifted unfavorably, with a decline in the proportion of patients meeting >80% of estimated energy needs (52.15% to 44.44%) and a corresponding increase in those consuming 50–80%. Protein intake was similarly inadequate (50.6±28.1 to 48.6±25.3 g/day), and the majority of patients were classified as having insufficient protein intake (80% at 2 weeks and 85% at 1 month). Collectively, these findings suggest persistent postoperative nutritional insufficiency that may contribute to ongoing malnutrition risk and underscore the need for structured dietary monitoring and timely nutrition support during early recovery.

Previous studies similarly report a high prevalence of inadequate energy and protein intake among patients with cancer. In a study by Timuraoglu et al. involving 71 patients, mean energy intake was approximately 1476 kcal/day, and nearly one-third of participants consumed less than their daily energy requirements; protein intake per kilogram was also below recommended levels(25). Notably, patients who received nutritional support had higher energy and protein intakes, highlighting the impact of dietetic interventions. Likewise, Ravasco et al. demonstrated in colorectal cancer patients that structured nutrition counseling was more effective than protein supplementation alone or an unrestricted diet in improving dietary intake and clinical outcomes, with benefits persisting for months after treatment(26). In our cohort, only a minority had prior nutrition counseling, which may partly explain the persistent dietary inadequacy observed after surgery. In addition, van der Werf et al. reported that more than half of hospitalized colorectal cancer patients experienced reduced dietary intake, indicating that poor intake is common across both inpatient and treatment settings(27). Finally, Barbosa et al. showed that malnourished patients had significantly lower daily energy intake than well-nourished patients (P<0.001), supporting our observation that reduced intake is closely linked to malnutrition severity(28).

In the present study, functional status assessed by the Karnofsky Performance Status suggested a modest postoperative decline over the first month. The mean Karnofsky was 72.13±13.67 (median 70;

range 50–100) at 2 weeks and decreased to 71.28±5.33 (median 70; range 50–100) at 1 month, while the proportion of patients requiring assistance with daily activities increased from 65% to 78%. In contrast, Ziętarska et al. reported substantially higher Karnofsky values (mean 90.5±7.7, median 90) in colorectal cancer patients assessed before chemotherapy, highlighting that differences in timing and clinical context (pre-treatment vs early postoperative recovery) may explain the discrepancy(29). The inverse association between PG-SGA and Karnofsky in our study further supports that poorer nutritional status is accompanied by worse functional performance, reinforcing the need for integrated postoperative nutrition and rehabilitation support.
physical function also appeared to deteriorate after surgery. Mean handgrip strength decreased from 23.61±8.06 kg (men) and 16.06±7.08 kg (women) at 2 weeks to 23.73±7.79 kg (men) and 16.32±7.10 kg (women) at 1 month, and the prevalence of low handgrip strength increased from 43% to 55% based on Iranian age- and sex-specific cut-offs. Compared with van Hinsbergen et al. (23% low handgrip; higher mean values), the higher rate of weakness in our cohort may reflect differences in population characteristics, the use of age-adjusted cut-offs, and clinical factors such as postoperative catabolism and the relatively high proportion of patients receiving neoadjuvant therapy(30). Together, these findings emphasize that early postoperative follow-up should include both nutritional assessment and muscle function monitoring to prevent further functional decline.
Adenocarcinoma was the predominant histology in our cohort (82.1%), consistent with prior reports in colorectal cancer (31, 32). Notably, adenocarcinoma was significantly associated with poorer nutritional status, which may reflect higher inflammatory burden, greater metabolic demands, and appetite suppression in more aggressive disease phenotypes. These findings support early identification of malnutrition risk and more targeted nutritional care in patients with adenocarcinoma (33).
Another relevant observation was that 27.6% of patients were unaware of their cancer diagnosis. Previous studies have reported wide variation in cancer awareness (23–96%), particularly in Middle Eastern settings where disclosure may be limited by family preferences (34, 35). In our study, lack of disease awareness was significantly associated with worse nutritional status, potentially due to reduced engagement with treatment and less attention to nutritional self-care, underscoring the importance of culturally sensitive patient communication and supportive counseling (36).
Regarding symptom burden, abdominal pain (85%), dyspepsia (50%), and anorexia (68%) were the most frequently reported symptoms. Similar symptom patterns have been described in colorectal cancer, including abdominal pain and bowel habit changes(28). Because many nutrition-impact symptoms are potentially modifiable, early recognition and integrated medical–nutritional management may improve intake and help prevent deterioration in nutritional status.
In this prospective postoperative follow-up of patients with colorectal cancer, nutritional risk and malnutrition were highly prevalent at both 2 weeks and 1 month after surgery, with a shift toward more severe PG-SGA categories over time. Early recovery was also characterized by inadequate energy and protein intake, unfavorable changes in anthropometric and body-composition indicators, and a high burden of nutrition-impact symptoms (particularly abdominal pain and anorexia). These findings highlight the first postoperative month as a critical window for routine, repeated nutritional assessment after discharge and timely, targeted nutrition care focused on symptom control and intake optimization. Future studies should evaluate whether structured post-discharge nutrition pathways improve nutritional and clinical outcomes in this population.
A notable strength is the broad, multi-domain postoperative assessment, combining PG-SGA with anthropometry and body composition and patient-reported outcomes, and nutritional intake allowing a more integrated understanding of nutritional status and its functional and psychosocial correlates. The study setting in a referral educational-treatment center and linkage to clinical teams were also described as supportive of data quality and feasibility.
A key limitation of this study was the inability to obtain laboratory measurements, as follow-up assessments were conducted in an outpatient clinic setting and many patients were unwilling to undergo blood sampling.
In addition, although two postoperative time points were captured, We recommend longer follow-up would be valuable to describe trajectories beyond the first month and to examine whether targeted interventions translate into improved nutritional and clinical outcomes.

Conclusion

This study revealed malnutrition were highly prevalent and tended to worsen during the first postoperative month after colorectal cancer surgery, alongside inadequate intake, worsening body-composition indices, and common nutrition-impact symptoms. These findings support routine, repeated post-discharge nutritional assessment and timely nutrition care focused on symptom management and intake optimization during early recovery.

Declarations

Ethics

This study was approved by the Research Ethics Committee (ethics committee code: IR.MUMS.MEDICAL.REC.1402.291) of Mashhad University of Medical Sciences (MUMS).

Conflict of interest

The Authors have no conflicts of interest to disclose.

Consent for publication

Consent has been obtained from all participants, stating that all information related to the research will be confidential, and only the overall and group results of this research will be published without mentioning their names or characteristics.

Funding

This study was supported by Mashhad University of Medical Sciences (MUMS) under a grant awarded to the corresponding author. Grant Number: 4011265

Availability of data and materials

The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

Author contribution

Sara Movahed contributed to designing the study, data collection, and writing the manuscript.
Nafiseh Alizadeh data collection, analyzing the data, and writing the manuscript.
Abbass Abdollahi contributed to designing the study, data collection and revision of the manuscript.
Maryam Emadzadeh contributed to designing the study, analyzing the data, and revising the manuscript.
Mohammad Moeini Nodeh contributed to designing the study, data collection and revision of the manuscript.
Zohre Abdolahi contributed to data collection.
Mahsa Chaji contributed to data collection.
Fatemeh Shabi data collection and writing the manuscript.

Acknowledgement

The authors would like to thank the Clinical Research Development Unit of Ghaem Hospital for cooperation in data analysis. This article is an excerpt from the thesis of the second author of the article in the master's degree in clinical nutrition, and was carried out with the support of Mashhad University of Medical Sciences.

References

1. Rawla P, Sunkara T, Barsouk A. Epidemiology of colorectal cancer: incidence, mortality, survival, and risk factors. Gastroenterology Review/Przegląd Gastroenterologiczny. 2019;14(2):89-103. https://doi.org/10.5114/pg.2018.81072
2. Mousavi SM, Younesian S, Katebian S, Golestani A, Khanmohammadi S, Khosravi S, et al. Temporal trend in the national and sub-national burden of cancers attributable to risk factors in Iran from 1990 to 2021: Findings from the global burden of disease study 2021. Plos one. 2025;20(8):e0330993. https://doi.org/10.1371/journal.pone.0330993
3. Roshandel G, Ferlay J, Ghanbari-Motlagh A, Partovipour E, Salavati F, Aryan K, et al. Cancer in Iran 2008 to 2025: recent incidence trends and short-term predictions of the future burden. International journal of cancer. 2021;149(3):594-605. https://doi.org/10.1002/ijc.33574
4. Wei J-N, Li S-X. The relationship between nutritional risks and cancer-related fatigue in patients with colorectal cancer fast-track surgery. Cancer nursing. 2018;41(6):E41-E7. https://doi.org/10.1097/NCC.0000000000000541
5. Vashi PG, Gorsuch K, Wan L, Hill D, Block C, Gupta D. Sarcopenia supersedes subjective global assessment as a predictor of survival in colorectal cancer. PLoS One. 2019;14(6):e0218761. https://doi.org/10.1371/journal.pone.0218761
6. Trollebø MA, Tangvik RJ, Skeie E, Grønning MK, Nygård O, Eagan TM, et al. Malnutrition as a prognostic factor for 2-year mortality in hospitalized patients in Norway: a matched cohort study. Journal of Parenteral and Enteral Nutrition. 2024;48(3):308-17. https://doi.org/10.1002/jpen.2619
7. Zhang L, Wang S, Gao X, Gao T, Huang L, Lian B, et al. Poor Pre-operative Nutritional Status Is a Risk Factor of Post-operative Infections in Patients With Gastrointestinal Cancer-A Multicenter Prospective Cohort Study. Frontiers in Nutrition. 2022;9:850063. https://doi.org/10.3389/fnut.2022.850063
8. Arends J, Bachmann P, Baracos V, Barthelemy N, Bertz H, Bozzetti F, et al. ESPEN guidelines on nutrition in cancer patients. Clinical nutrition. 2017;36(1):11-48. https://doi.org/10.1016/j.clnu.2016.07.015
9. Faramarzi E, Mahdavi R, Mohammad-Zadeh M, Nasirimotlagh B. Validation of nutritional risk index method against patient-generated subjective global assessment in screening malnutrition in colorectal cancer patients. Chinese Journal of Cancer Research. 2013;25(5):544. doi: 10.3978/j.issn.1000-9604.2013.10.04.
10. Jamshidi S, Hejazi N, Zimorovat AR. Nutritional status in patients with gastrointestinal cancer in comparison to other cancers in Shiraz, Southern Iran: a case-control study. World journal of plastic surgery. 2018;7(2):186.
11. Khoshnevis N, Ahmadizar F, Alizadeh M, Akbari M. Nutritional assessment of cancer patients in Tehran, Iran. Asian Pacific Journal of Cancer Prevention. 2012;13(4):1621-6. https://doi.org/10.7314/APJCP.2012.13.4.1621
12. Sarvarian R, Khoshnevis N, Amiri Z, Haghighian Roudsari A, Rashidi A. Prevalence of malnutrition and its relationship to socio-economic variables for cancer patients admitted to Shohada-ye-Tajrish hospital in 2010. Iranian Journal of Nutrition Sciences and Food Technology. 2013;8(3):261-7. Doi:10.22038/jnfh.2020.50776.1283
13. Payab M, Motlagh A-rD, Eshraghian M, Rostami R, Siassi F, Abbasi B, et al. The association between depression, socio-economic factors and dietary intake in mothers having primary school children living in Rey, South of Tehran, Iran. Journal of Diabetes & Metabolic Disorders. 2012;11(1):26. https://doi.org/10.1186/2251-6581-11-29
14. Bauer J, Capra S, Ferguson M. Use of the scored Patient-Generated Subjective Global Assessment (PG-SGA) as a nutrition assessment tool in patients with cancer. European journal of clinical nutrition. 2002;56(8):779-85. https://doi.org/10.1038/sj.ejcn.1601412
15. Shahabbasi J, Jager-Wittenaar H, Ottery F, Asghari-Jafarabadi M, Ghoreishy Z, Dolatkhah R, et al. Cross Cultural Adaptation and Validation of the" Patient-Generated Subjective Global

Assessment (PG-SGA)" for Nutritional Status Assessment of Cancer Patients. Depiction of health. 2018;9(3):149-58.
16. Chao P-C, Chuang H-J, Tsao L-Y, Chen P-Y, Hsu C-F, Lin H-C, et al. The Malnutrition Universal Screening Tool (MUST) and a nutrition education program for high risk cancer patients: strategies to improve dietary intake in cancer patients. Biomedicine. 2015;5(3):17. https://doi.org/10.7603/s40681-015-0017-6
17. Cederholm T, Jensen G, Correia M, Gonzalez MC, Fukushima R, Higashiguchi T, et al. GLIM criteria for the diagnosis of malnutrition-a consensus report from the global clinical nutrition community. Journal of cachexia, sarcopenia and muscle. 2019;10(1):207-17. https://doi.org/10.1002/jcsm.12383
18. Muscaritoli M, Arends J, Bachmann P, Baracos V, Barthelemy N, Bertz H, et al. ESPEN practical guideline: Clinical Nutrition in cancer. Clinical nutrition. 2021;40(5):2898-913. https://doi.org/10.1016/j.clnu.2021.02.005
19. Shah S. Common terminology criteria for adverse events. National Cancer Institute: USA. 2022;784:785.
20. Mohammadian M, Choobineh A, Haghdoost A, Hasheminejad N. Normative data of grip and pinch strengths in healthy adults of Iranian population. Iranian journal of public health. 2014;43(8):1113.
21. Karin M, Bogut A, Hojsak I, Babić E, Volarić M, Bevanda M. Nutritional status and its effect on complications in patients with colorectal cancer. Wiener klinische Wochenschrift. 2020;132(15):431-7. https://doi.org/10.1007/s00508-020-01671-4
22. Soria-Utrilla V, Sánchez-Torralvo FJ, González-Poveda I, Mera-Velasco S, Porras N, Toval-Mata JA, et al. Prevalence of anxiety and depression symptoms and their relationship with nutritional status and mortality in patients with colorectal cancer. International Journal of Environmental Research and Public Health. 2022;19(20):13548. https://doi.org/10.3390/ijerph192013548
23. Nunes GD, Cardenas LZ, Miola TM, Souza JdO, Carniatto LN, Bitencourt AGV. Preoperative evaluation of sarcopenia in patients with colorectal cancer: a prospective study. Revista da Associação Médica Brasileira. 2023;69:222-7. https://doi.org/10.1590/1806-9282.20220339
24. Wang WJ, Li TT, Wang X, Li W, Cui JW. Combining the Patient-Generated Subjective Global Assessment (PG-SGA) and objective nutrition assessment parameters better predicts malnutrition in elderly patients with colorectal cancer. Journal of Nutritional Oncology. 2020;5(1):22-30. https://doi.org/10.34175/jno202001003
25. Timuroğlu A, Menteş S, Muslu S, Ünver S, Çelebi SM, Uzunoğlu K. Protein Energy Intake in Hospitalized Cancer Patients: Point Prevalence Research. Clinical Science of Nutrition. 2023;5(2):70-5. https://doi.org/10.5152/ClinSciNutr.2023.23060
26. Ravasco P. Nutrition in cancer patients. Journal of clinical medicine. 2019;8(8):1211. https://doi.org/10.3390/jcm8081211
27. van der Werf A, Arthey K, Hiesmayr M, Sulz I, Schindler K, Laviano A, et al. The determinants of reduced dietary intake in hospitalised colorectal cancer patients. Supportive Care in Cancer. 2018;26(6):2039-47. https://doi.org/10.1007/s00520-018-4044-1
28. Barbosa LRL, Lacerda-Filho A, Barbosa LCL. Immediate preoperative nutritional status of patients with colorectal cancer: a warning. Arquivos de gastroenterologia. 2014;51(4):331-6. https://doi.org/10.1590/S0004-28032014000400012
29. Ziętarska M, Krawczyk-Lipiec J, Kraj L, Zaucha R, Małgorzewicz S. Nutritional status assessment in colorectal cancer patients qualified to systemic treatment. Contemporary Oncology/Współczesna Onkologia. 2017;21(2):157-61. https://doi.org/10.5114/wo.2017.68625
30. Van Heinsbergen M, Konsten J, Bours M, Bouvy N, Weijenberg M, Janssen-Heijnen M. Preoperative handgrip strength is not associated with complications and health-related quality of life after surgery for colorectal cancer. Scientific Reports. 2020;10(1):13005. https://doi.org/10.1038/s41598-020-69806-1
31. Santy ST, Djafar NH, Selomo PAM. Clinicopathologic Features Of Colorectal Cancer At RSUD Dr. H. Chasan Boesoirie Ternate 2018-2023. AVERROUS: Jurnal Kedokteran dan Kesehatan Malikussaleh. 2024:71-80. https://doi.org/10.29103/averrous.v10i1.15653
32. Aulia FF, Rachmawati M, Junus A, editors. Grading Tumor Pasien Adenocarcinoma Colorectal di RS Dr. Hasan Sadikin Bandung Tahun 2015. Bandung Conference Series: Medical Science; 2022. https://doi.org/10.29313/bcsms.v2i1.955
33. Nasseri Y, Cox B, Shen W, Zhu R, Stettler I, Cohen J, et al. Adenosquamous carcinoma: An aggressive histologic sub-type of colon cancer with poor prognosis. The American Journal of Surgery. 2021;221(3):649-53. https://doi.org/10.1016/j.amjsurg.2020.07.038
34. Storlien MEO. The effect of marine protein hydrolysates on biomarkers related to muscle synthesis and degradation following exhaustive endurance cycling in healthy males: The University of Bergen; 2019.
35. Alzahrani AS, Alqahtani A, Alhazmi M, Gaafar R, Bajabir D, Alharbi IM, et al. Attitudes of cancer patients and their families toward disclosure of cancer diagnosis in Saudi Arabia: a Middle Eastern population example. Patient preference and adherence. 2018:1659-66. https://doi.org/10.2147/PPA.S176651
36. Baek SK, Kim S-y, Heo DS, Yun YH, Lee MK. Effect of advanced cancer patients' awareness of disease status on treatment decisional conflicts and satisfaction during palliative chemotherapy: a Korean prospective cohort study. Supportive Care in Cancer. 2012;20(6):1309-16. https://doi.org/10.1007/s00520-011-1218-5