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Original Communication

Post-Discharge Management Improves Nutritional Status and Quality of Life in Postoperative Patients With Gastrointestinal Cancer

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Abstract

Background: Post-discharge management refers to the health education, lifestyle guidance, and follow-up care provided to discharged patients. However, data on the effectiveness of post-discharge management after gastrectomy or colectomy remain limited. Therefore, this study aimed to assess the effectiveness of post-discharge management on the nutritional status and quality of life in postoperative patients with gastric cancer (GC) or colon cancer (CC). **Methods:** A total of 151 adult patients with GC or CC treated at our institution from June 2024 to February 2025 were randomly assigned to intervention or control groups. In addition to verbal discharge education provided to both groups, the intervention group also received 3 months of post-discharge management, defined as comprehensive post-discharge health education covering lifestyle, dietary nutrition, and other aspects. Differences in nutritional status and quality of life between groups were investigated. **Results:** When compared with the control group, the GC intervention group exhibited less weight loss (–0.75 (–3.00, 0.50) kg vs. –2.75 (–4.50, –1.00) kg; Z = –2.31, $p = 0.02$), a smaller decrease in Body Mass Index (BMI) (–0.29 (–1.20, 0.20) kg/m^2 vs. –0.97 (–1.64, –0.39) kg/m^2; Z = –2.32, $p = 0.02$), a greater increase in serum albumin levels (7.25 (6.25, 9.85) g/L vs. 4.90 (3.15, 9.00) g/L; Z = –2.20, $p = 0.03$), and enhanced handgrip strength (3.20 (2.25, 4.18) kg vs. 0.50 (–0.35, 1.30) kg; Z = –6.35, $p < 0.01$) 1 month post-discharge. Furthermore, the prevalence of malnutrition, as defined by the Global Leadership Initiative on Malnutrition, was lower (56.3% vs. 77.5%; $p = 0.04$) 1 month after discharge. Additionally, the group exhibited less weight loss (0.25 (–2.88, 2.50) kg vs. –3.00 (–3.50, 0.13) kg; Z = –2.53, $p = 0.01$), a smaller decrease in BMI (0.08 (–1.13, 0.95) kg/m^2 vs. –1.04 (–1.34, 0.04) kg/m^2; Z = –2.48, $p = 0.01$), and a more substantial increase in handgrip strength (4.85 (2.08, 5.85) kg vs. 1.05 (–0.23, 1.93) kg; Z = –5.62, $p < 0.01$) at 3 months after discharge. The CC intervention group had increased handgrip strength at one and three months after discharge (1st month: 4.50 (2.93, 5.53) kg vs. 1.10 (0.10, 2.10) kg, Z = –4.98, $p < 0.01$; 3rd month: 5.80 (4.70, 8.60) kg vs. 1.55 (0.00, 2.58) kg, Z = –4.98, $p < 0.01$). Moreover, both the GC and CC intervention groups showed superior physical function, role function, social function, and appetite compared with the control groups at 1 and 3 months after discharge ($p < 0.05$). **Conclusions:** Regardless of whether the patient has GC or CC, post-discharge management improves nutritional status and quality of life in postoperative patients. Therefore, post-discharge management should be applied in clinical practice. **Clinical Trial Registration:** This trial was registered at the Chinese Registry of Clinical Trials (ChiCTR2400084776, https://www.chictr.org.cn/bin/userProject).

Keywords: post-discharge management; nutritional status; quality of life; gastric cancer; colon cancer

1. Introduction

Gastric cancer (GC) and colon cancer (CC) are the most common malignant tumours of the digestive system and seriously threaten patient health. According to the 2020 global cancer statistics, there were 1.09 million new cases and 0.77 million deaths worldwide in 2020 for GC, and 1.15 million new cases and 0.58 million deaths worldwide in 2020 for CC [1]. In China, the new cases of stomach and colorectal cancers showed an increasing trend from 1990 to 2021, with absolute changes of 50.15% and 315.64%, respectively [2]. Due to abnormal metabolism and digestive dysfunction, the incidence rates of malnutrition in patients with GC and CC are 60.2% and 39.3%, respectively [3]. Due to surgical stress, malnutrition is prone to worsening in the early postoperative period, particularly after hospital discharge [4], leading to a high incidence of postoperative complications [5], reduced quality of life [6], and poor tolerance to adjuvant therapy [7]. Moreover, Yalcin et al. [8] showed that 20% to 40% of patients with cancer mortality was closely related to malnutrition.

Owing to the lack of professional dietary and comprehensive rehabilitation guidance, patients with cancer discharged after surgery are prone to malnourishment in the early stages, thus affecting postoperative recovery and reducing quality of life. Consequently, post-discharge management was established based on the common needs of discharged patients.

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Post-discharge management refers to extended professional medical services provided to discharged patients. Linked to inpatient treatment, it delivers guidance on postoperative matters, complication prevention, cancer treatment, follow-up arrangements, diet, nutrition, psychology and exercise to patients, thus helping them to recover quickly. However, research on the post-discharge management of GC and CC remains limited. From a mechanistic perspective, establishing patients' trust in doctors is the foundation for the smooth progress of medical services, and unobstructed communication serves as a prerequisite for building trust [9]. Therefore, every patient should leave the hospital with a follow-up phone number to call in case of concerns or questions [10]. Additionally, discharged patients are anxious about unresolved issues such as wound suture removal, which should be included in post-discharge management to ensure that they are followed up and addressed. Moreover, given that family members serve as an important force in compliance with doctors' orders for most discharged patients and in supervising and encouraging patients, post-discharge management should encourage family members to participate in health education and communication [11]. This study aimed to determine the effects of post-discharge management through a prospective randomised controlled trial.

2. Materials and Methods

2.1 Study Design

This was a single-centre, prospective, randomised, controlled study. This study was registered at https://www.chictr.org.cn (ChiCTR2400084776). Approval was obtained from patients who underwent gastrectomies or colectomies between June 2024 and February 2025 at Shaoxing People's Hospital. Individuals eligible to participate in this study met the following inclusion criteria: (1) age 18 years or older, (2) diagnosed with GC or CC, (3) clear mind, smooth communication, willingness to accept questionnaire surveys, and dietary guidance, and (4) nutritional risk (Nutritional Risk Screening 2002 $\geq$3). Patients were ineligible for this study if they met any of the following exclusion and withdrawal criteria: (1) lost to follow-up, (2) cognitive impairment or speech disturbance, (3) concomitant serious organ diseases or major surgical complications, and (4) pregnancy or lactation. The sample size was calculated by conducting a power analysis G*Power v3.1 (Kiel, Schleswig-Holstein, Germany) based on a similar study [12]. Detailed data are presented in the **Supplementary Materials**. 1-month postoperative incidence of Global Leadership Initiative on Malnutrition (GLIM)-defined malnutrition was selected as the primary endpoint.

2.2 Randomization and Allocation

Random sequence generator who was not involved in patient recruitment and outcome assessment generated separate random allocation sequences for GC patients and CC patients in advance via the random number table. For GC patients, odd numbers corresponded to allocation to the intervention group, while even numbers corresponded to the control group. Patients with CC were allocated using the reversed coding logic. Random sequence generator placed the allocation results into sequentially numbered, sealed, opaque envelopes. Envelopes for GC and CC patients were stored separately in two independent locked filing cabinets kept solely by the random sequence generator. Upon participant enrollment, after participants signed informed consent and completed baseline data collection, patient recruiter who did not conduct outcome assessments telephoned the random sequence generator to request the corresponding envelope according to the enrollment order of each participant. Participants were assigned to groups following the predetermined allocation inside the envelopes, ensuring the recruiter could not predict the group allocation in advance.

Three independent roles were established in this study: ① Random sequence generator: Responsible solely for generating the random allocation sequence and storing allocation envelopes, with no involvement in any clinical procedures. ② Patient recruiter: Responsible for providing participants with a full introduction, collecting baseline data, and opening allocation envelopes at enrollment. Patient recruiter was not involved in outcome assessment. ③ Outcome assessor: Responsible for evaluating efficacy indicators during follow-up and remained completely blinded to group allocation (single-blind design). Allocation concealment was achieved through physical separation (All envelopes stored in a locked filing cabinet) and procedural isolation (Patient recruiter requested envelopes from the random sequence generator). Researchers responsible for random sequence generation, patient recruitment, and outcome assessment were distinct individuals. Three types of personnel worked independently without mutual interference.

This study adopted a single-blind design with blinding applied to outcome assessors, who remained unaware of group allocation. Moreover, the unblinding procedure was formulated as follows: If a serious adverse event occurs during follow-up or a participant requires emergency resuscitation, necessitating urgent unblinding, the attending physician shall submit a written request to the random sequence generator. After approval by the principal investigator, the random sequence generator will open the corresponding envelope alone and inform the attending physician of the group allocation. Unblinding information is restricted exclusively to the attending physician and must not be disclosed to the outcome assessor. Once unblinding takes place, the participant will be excluded from the efficacy analysis set, while their safety data will still be retained for analysis.

A total of 96 GC patients were included, with 52 cases in the intervention group and 44 cases in the control group. And a total of 55 CC patients were enrolled, including 26 cases in the intervention group and 29 cases in the control group. Overall, 151 patients were enrolled in the study.

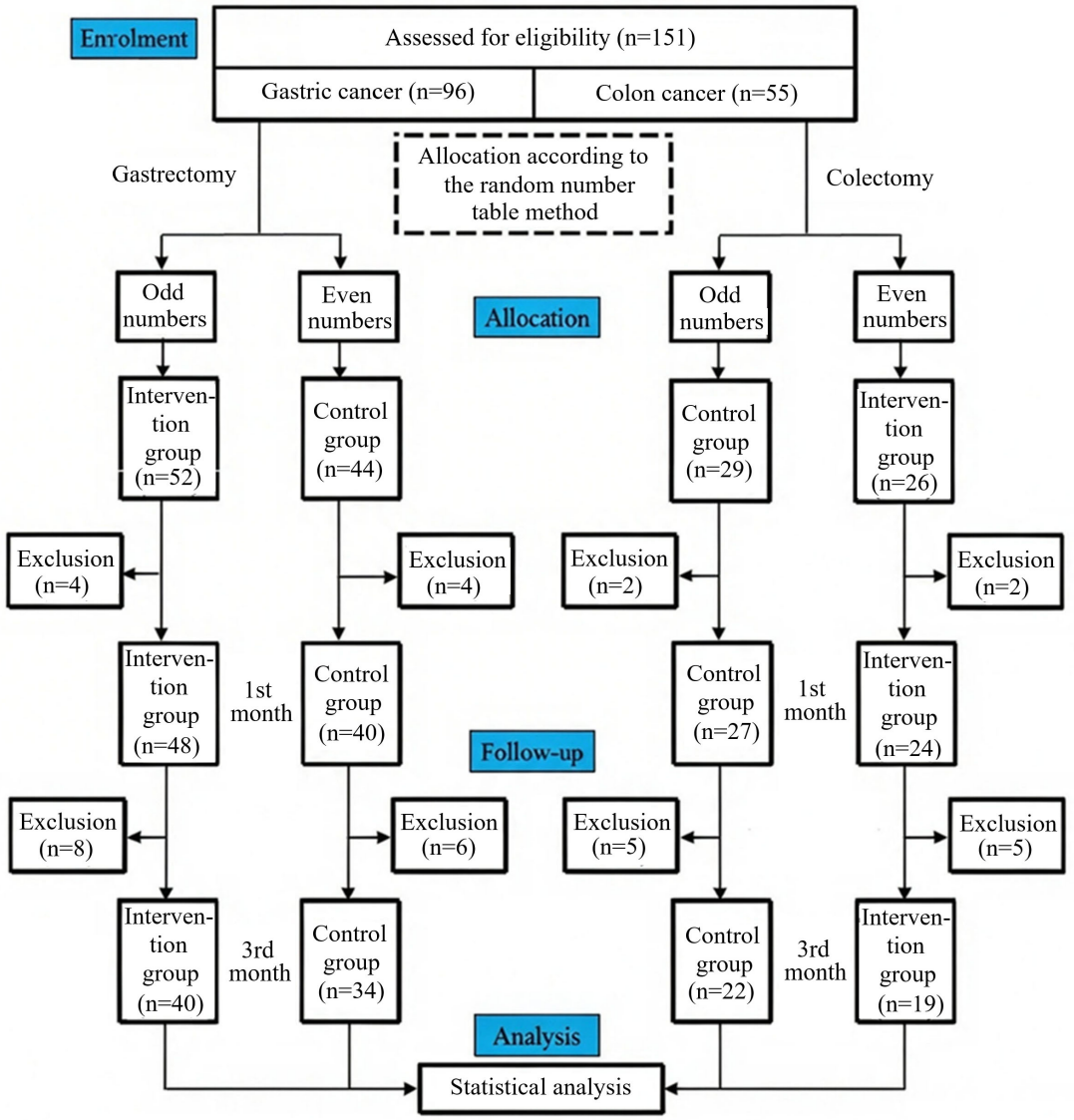


Fig. 1. Flowchart of this study.

Finally, 139 patients were followed up 1 month after discharge, including 88 patients with GC (48 cases in the intervention group and 40 cases in the control group) and 51 patients with CC (24 cases in the intervention group and 27 cases in the control group). 115 patients were followed up 3 months after discharge, including 74 patients with GC (40 cases in the intervention group and 34 cases in the control group) and 41 patients with CC (19 cases in the intervention group and 22 cases in the control group) (Fig. 1). The baseline characteristics of intervention and control groups at discharge were compared for both GC and CC except for albumin (Table 1a,1b, $p > 0.05$).

2.3 Intervention

No significant differences were found between the intervention and control groups in terms of postoperative follow-up, postoperative chemotherapy, or other comprehensive treatments. The only difference was in the implementation of post-discharge management. All patients received verbal discharge education from nurses before discharge, which followed a standardised protocol covering dietary, medication, and follow-up guidance. First, patients were instructed to adopt small, frequent meals with high-quality protein food, and avoid irritating or pickled foods. Second, patients were required to take medicines regularly per discharge instructions and never discontinue treatment without medical permission. Third, scheduled follow-up was needed 1 month after discharge, and immediate medical consultation was mandatory once discomfort occurred. In addition to oral discharge education, patients in the intervention groups participated in a set of systematic post-discharge management services for up to 3 months, which provided them with a complete set of relevant knowledge, including postoperative dietary instructions, strategies for decreased appetite, prevention and treatment of surgical complications, strategies for postoperative adverse reac-

Table 1a. Characteristics of the participants at discharge after surgery.

Baseline characteristics	GI (n = 52)	GC (n = 44)	CI (n = 26)	CC (n = 29)	GI vs. GC Z/X^2, *p*	CI vs. CC Z/X^2, *p*	AI (n = 78)	AC (n = 73)	AI vs. AC Z/X^2, *p*
Age (years)	70.0 (63.0, 76.0)	71.0 (60.0, 76.0)	70.0 (64.0, 76.0)	70.0 (59.0, 78.0)	Z = –0.27, 0.79	Z = –0.08, 0.93	70.0 (64.0, 76.0)	70.0 (60.0, 77.0)	Z = –0.25, 0.81
Sex (male/female)	39/13	27/17	15/11	18/11	X^2 = 2.06, df = 1, *p* = 0.15	X^2 = 0.11, df = 1, *p* = 0.74	54/24	45/28	X^2 = 0.96, df = 1, *p* = 0.33
TNM classification									
I/II/III/IV	19/10/22/1	19/11/14/0	3/9/11/3	6/12/10/1	Z = –1.10, 0.27	Z = –1.41, 0.16	22/19/33/4	25/23/24/1	Z = –1.54, 0.12
Nutritional indices									
Albumin (g/L)	30.7 (27.7, 33.0)	32.1 (29.4, 34.6)	32.5 (30.8, 33.5)	34.4 (31.3, 36.7)	Z = –1.88, 0.06	Z = –2.01, 0.05	31.8 (28.5, 33.0)	33.2 (30.0, 35.1)	Z = –2.80, 0.01
Haemoglobin (g/L)	102 (83.0, 119)	109 (93.0, 121)	112 (91.5, 117)	107 (96.0, 117)	Z = –1.75, 0.08	Z = –0.20, 0.84	105 (88.0, 118)	108 (95.5, 120)	Z = –1.40, 0.16
Handgrip strength (kg)	28.5 (23.1, 32.4)	27.5 (23.8, 34.7)	28.1 (19.3, 33.6)	26.7 (18.5, 35.4)	Z = –0.15, 0.88	Z = –0.17, 0.87	28.5 (21.5, 33.0)	26.9 (21.6, 35.2)	Z = –0.19, 0.85
Body weight (kg)	59.3 (49.6, 66.8)	58.8 (53.0, 63.5)	56.0 (48.9, 62.8)	59.0 (52.8, 65.5)	Z = –0.27, 0.79	Z = –1.05, 0.29	58.8 (49.4, 65.0)	59.0 (53.0, 64.5)	Z = –0.83, 0.41
BMI (kg/m^2)	21.5 (19.5, 23.4)	21.3 (20.0, 24.9)	20.8 (19.6, 24.5)	22.8 (19.1, 25.6)	Z = –0.50, 0.62	Z = –0.95, 0.34	21.2 (19.5, 23.6)	21.5 (19.9, 25.1)	Z = –1.08, 0.28
Malnutrition diagnosed per GLIM criteria									
-/+	34/18	27/17	18/8	17/12	X^2 = 0.17, df = 1, *p* = 0.68	X^2 = 0.67, df = 1, *p* = 0.41	52/26	44/29	X^2 = 0.67, df = 1, *p* = 0.42

Note: GI, gastric cancer intervention group; GC, gastric cancer control group; CI, colon cancer intervention group; CC, colon cancer control group; AI, all intervention groups; AC, all control groups; TNM, Tumor-Node-Metastasis staging system; BMI, Body Mass Index; GLIM, Global Leadership Initiative on Malnutrition.

Table 1b. Characteristics of the participants at discharge after surgery.

EORTC QLQ-C30 score	GI (n = 52)	GC (n = 44)	CI (n = 26)	CC (n = 29)	GI vs. GC Z/X^2, *p*	CI vs. CC Z/X^2, *p*	AI (n = 78)	AC (n = 73)	AI vs. AC Z/X^2, *p*
Global health and QOL scale	50.0 (41.7, 66.7)	58.3 (33.3, 66.7)	58.3 (50.0, 68.8)	66.7 (50.0, 75.0)	Z = –0.52, 0.60	Z = –0.34, 0.74	58.3 (50.0, 66.7)	58.3 (50.0, 66.7)	Z = –0.84, 0.40
Physical functioning	73.3 (60.0, 86.7)	73.3 (61.7, 86.7)	66.7 (60.0, 80.0)	73.3 (56.7, 86.7)	Z = –0.32, 0.75	Z = –0.49, 0.62	73.3 (60.0, 86.7)	73.3 (60.0, 86.7)	Z = –0.58, 0.56
Role functioning	66.7 (50.0, 83.3)	66.7 (50.0, 83.3)	66.7 (66.7, 83.3)	83.3 (50.0, 83.3)	Z = –0.33, 0.74	Z = –0.28, 0.78	66.7 (50.0, 83.3)	66.7 (50.0, 83.3)	Z = –0.43, 0.66
Emotional functioning	91.7 (75.0, 100)	91.7 (66.7, 100)	87.5 (66.7, 100)	91.7 (66.7, 100)	Z = –0.23, 0.82	Z = –0.22, 0.83	91.7 (75.0, 100)	91.7 (66.7, 100)	Z = –0.10, 0.92
Cognitive functioning	83.3 (66.7, 100)	83.3 (66.7, 100)	83.3 (66.7, 100)	83.3 (66.7, 100)	Z = –0.05, 0.96	Z = –0.11, 0.91	83.3 (66.7, 100)	83.3 (66.7, 100)	Z = –0.01, 1.00
Social functioning	75.0 (66.7, 83.3)	66.7 (66.7, 83.3)	83.3 (66.7, 83.3)	66.7 (66.7, 83.3)	Z = –0.23, 0.82	Z = –0.11, 0.92	83.3 (66.7, 83.3)	66.7 (66.7, 83.3)	Z = –0.25, 0.80
Fatigue	22.2 (11.1, 33.3)	33.3 (11.1, 33.3)	33.3 (11.1, 36.1)	33.3 (11.1, 44.4)	Z = –0.32, 0.75	Z = –0.10, 0.92	33.3 (11.1, 33.3)	33.3 (11.1, 44.4)	Z = –0.08, 0.94
Pain	16.7 (0.00, 33.3)	16.7 (0.00, 33.3)	16.7 (0.00, 33.3)	16.7 (0.00, 33.3)	Z = –0.43, 0.67	Z = –0.73, 0.47	16.7 (0.00, 33.3)	16.7 (0.00, 33.3)	Z = –0.10, 0.92
Nausea and vomiting	0.00 (0.00, 16.7)	0.00 (0.00, 16.7)	0.00 (0.00, 33.3)	16.7 (0.00, 16.7)	Z = –0.33, 0.74	Z = –0.71, 0.48	0.00 (0.00, 16.7)	0.00 (0.00, 16.7)	Z = –0.29, 0.77
Dyspnoea	0.00 (0.00, 33.3)	0.00 (0.00, 33.3)	16.7 (0.00, 33.3)	0.00 (0.00, 33.3)	Z = –0.35, 0.73	Z = –0.14, 0.89	0.00 (0.00, 33.3)	0.00 (0.00, 33.3)	Z = –0.21, 0.83
Insomnia	0.00 (0.00, 33.3)	33.3 (0.00, 33.3)	33.3 (0.00, 33.3)	33.3 (0.00, 33.3)	Z = –0.84, 0.40	Z = –0.22, 0.83	0.00 (0.00, 33.3)	33.3 (0.00, 33.3)	Z = –0.55, 0.58
Appetite loss	16.7 (0.00, 33.3)	0.00 (0.00, 33.3)	33.3 (0.00, 33.3)	0.00 (0.00, 33.3)	Z = –0.02, 0.98	Z = –0.43, 0.67	33.3 (0.00, 33.3)	0.00 (0.00, 33.3)	Z = –0.24, 0.81
Constipation	0.00 (0.00, 33.3)	0.00 (0.00, 0.00)	0.00 (0.00, 66.7)	0.00 (0.00, 33.3)	Z = –0.82, 0.41	Z = –0.33, 0.74	0.00 (0.00, 33.3)	0.00 (0.00, 16.5)	Z = –0.66, 0.51
Diarrhoea	0.00 (0.00, 0.00)	0.00 (0.00, 0.00)	0.00 (0.00, 0.00)	0.00 (0.00, 33.3)	Z = –0.31, 0.76	Z = –1.42, 0.16	0.00 (0.00, 0.00)	0.00 (0.00, 33.3)	Z = –1.28, 0.20
Financial difficulties	0.00 (0.00, 33.3)	16.7 (0.00, 33.3)	33.3 (0.00, 33.3)	33.3 (0.00, 33.3)	Z = –0.16, 0.88	Z = –0.39, 0.70	16.7 (0.00, 33.3)	33.3 (0.00, 33.3)	Z = –0.08, 0.94

EORTC QLQ-C30, European Organization for Research and Treatment of Cancer Quality of Life Questionnaire-Core 30; QOL, Quality of Life.

Table 2. Post-discharge management implementation protocol.

Post-discharge phase (3 months)	Health education content	Intervention time (frequency)	Delivery mode*	Single-session duration	Communicator (professional qualification)	Professional support team members (professional qualifications)
Early stage (1 month after discharge)						
	① Postoperative precautions	Twice in Week 1 and once in Week 2	Messages were sent to patients for self-reading	The reading duration is 10 minutes	Qualifications of health managers	Gastroenterology oncology specialists (licensed physicians) Special nurses (licensed nurses)
	② Guidance on prevention and treatment of complications	Three times in Week 1	Messages were sent to patients for self-reading	The reading duration is 10 minutes	Qualifications of health managers	Gastroenterology oncology specialists (licensed physicians)
	③ Knowledge about cancer treatment	Twice in Week 1 and once in Week 2	Messages were sent to patients for self-reading	The reading duration is 10 minutes	Qualifications of health managers	Gastroenterology oncology specialists (licensed physicians)
	④ Follow-up guidance	Once in Week 1	Messages were sent to patients for self-reading	The reading duration is 5 minutes	Qualifications of health managers	Gastroenterology oncology specialists (licensed physicians)
	⑤ Dietary and nutritional guidance	Once in Week 1 and once in Week 2	Messages were sent to patients for self-reading	The reading duration is 10 minutes	Qualifications of health managers	Clinical nutritionists (registered clinical dietitian)
Mid-to-late stage (2–3 months after discharge)						
	① Psychological guidance	Twice in Month 2	Messages were sent to patients for self-reading	The reading duration is 10 minutes	Qualifications of health managers	Psychological counselors (professional credential of psychological counselor)
	② Exercise guidance	Twice in Month 3	Messages were sent to patients for self-reading	The reading duration is 10 minutes	Qualifications of health managers	Exercise rehabilitation therapists (professional credential of rehabilitation therapist)

*Messages were sent to patients for self-reading. Each reading session lasted 5–10 minutes. Patients could review the content repeatedly. They could contact the health manager by phone if they had any questions. There was no written intervention manual.

tions, significance of postoperative chemotherapy, exercise therapy implementation, post-discharge follow-up cooperation, and basic cancer knowledge (Table 2). Once patients encountered difficulties, they promptly received professional guidance from the post-discharge management team which comprised health managers, clinical nutritionists, rehabilitation therapists, psychological counsellors, gastroenterology oncology specialists and special nurses.

During the face-to-face follow-up assessments at the first and third months after discharge, all patients in the intervention groups reported having read the health education messages upon inquiry (100% learning rate). Questionnaire surveys revealed that GC patients in the intervention group had a good grasp of post-discharge management knowledge, with mean knowledge accuracy rates of 99.6% (1 month after discharge) and 97.8% (3 months after discharge). Their implementation compliance was also satisfactory, reaching a mean rate of 99.4% (1 month after discharge) and 97.5% (3 months after discharge). Similarly, CC patients in the intervention group demonstrated strong knowledge mastery and high implementation compliance, with mean knowledge accuracy rates of 99.6% (1 month after discharge) and 97.4% (3 months after discharge), and mean implementation adherence rates of 99.6% and 96.8%, respectively.

2.4 Follow-Up and Effects Observation

Regarding follow-up, routine assessments were conducted at the 1st and 3rd months after discharge from surgery, including regular measurements of serum albumin and haemoglobin, as well as in-person interviews lasting more than half an hour. Data on nutritional status and

quality of life were collected. The European Organization for Research and Treatment of Cancer Quality of Life Questionnaire-Core 30 (EORTC QLQ-C30) scale was used to evaluate quality of life.

2.4.1 Laboratory Nutrition-Related Indicators

Data on serum albumin and haemoglobin levels were collected from participants at discharge as well as at 1 and 3 months after discharge. Laboratory nutrition-related indicators in both groups were compared and analysed.

2.4.2 Routine Nutrition-Related Indicators

Data on the GLIM criteria, body weight, Body Mass Index (BMI), and handgrip strength were collected from participants at discharge before intervention, as well as at 1 and 3 months after intervention. Handgrip strength was measured twice consecutively on one hand using a handgrip dynamometer (Camry EH101, Jinhua, China), and the maximum value was recorded. Routine nutrition-related indicators in both groups were compared and analysed.

2.4.3 Nutritional Risk Screening and Nutritional Status Assessment

The Nutritional Risk Screening 2002 (NRS2002) assessment was used to screen patients for nutritional risks. Patients with the nutritional risk score of 3 or higher were considered to have nutritional risks and subjected to GLIM malnutrition rating assessment. The GLIM malnutrition diagnostic criteria consisted of three phenotypic indicators and two etiological indicators. According to the second step of the GLIM criteria, a diagnosis of malnutrition must meet at least one phenotypic and one etiological indicator [13]. Phenotypic indicators included nonautonomous weight loss (weight loss >5% within 6 months or weight loss >10% over 6 months), BMI <18.5 kg/m^2 within 70 years of age or BMI <20 kg/m^2 over 70 years of age, and muscle mass loss. Owing to the lack of consistent standards for muscle mass, this study selected weight loss and low BMI as the two of the phenotypic assessment indicators, excluding muscle mass loss [14]. Etiological indicators included reduced food intake, decreased absorption function (food intake ≤50% of normal requirement for more than 1 week, or any degree of intake reduction for more than 2 weeks, or absorption disorders caused by chronic gastrointestinal symptoms like dysphagia, nausea, vomiting, diarrhea, constipation and abdominal pain), and inflammation. Chronic or recurrent mild-to-moderate inflammation was related to malignant disease, whereas severe inflammation was related to major infection. According to the GLIM criteria, the severity grading of malnutrition was based on the degree of loss for the phenotypic criteria only [13]. Severe malnutrition was defined as follows: weight loss >10% in the past 6 months or >20% in more than 6 months, BMI <18.5 kg/m^2 within 70 years of age or BMI <20 kg/m^2 over 70 years of age [15]. Moderate malnutrition was defined as follows: weight loss 5–10% in the past 6 months or 10–20% in more than 6 months, BMI <20 kg/m^2 within 70 years of age or BMI <22 kg/m^2 over 70 years of age.

2.4.4 Quality of Life Assessment

EORTC QLQ-C30 scale was used to evaluate the quality of life from five functioning scales (physical, role, emotional, cognitive, and social functioning), three symptom scales (fatigue, pain, and nausea and vomiting), six single symptom items (dyspnoea, insomnia, appetite loss, constipation, diarrhoea, and financial difficulties) and two overall health status scales. The overall health status scales (items 29 and 30) in the questionnaire were positive items, divided into seven levels, whereas the other scales and single items (items 1–28) were negative items divided into four levels. The original scores were converted into percentages [16]. Higher percentages of functioning scales and overall health status scales indicated better functionality and better quality of life, while higher percentages of symptom scales and single items indicated more symptoms and worse quality of life.

2.5 Statistical Analysis

All statistical analyses were conducted using software IBM SPSS Statistics 32.0 (IBM Corp., Armonk, NY, USA). The ranked data were analysed by using the rank-sum test. Results were presented as median (25th percentile, 75th percentile) [median (P25, P75)]. Enumeration data were analysed using the chi-square test or Fisher's exact test. If $p < 0.05$, differences were considered statistically significant.

3. Results

3.1 Nutritional Status

Based on 3 months of observation, the nutritional variables of the intervention groups significantly improved when compared to those of the control groups 1 month after discharge, especially for GC. No new significant differences were observed between them at the third month of follow-up. The GC intervention group showed a greater increase in albumin levels (7.25 (6.25, 9.85) g/L vs. 4.90 (3.15, 9.00) g/L; Z = –2.20, $p = 0.03$) and a lower prevalence of GLIM-defined malnutrition (56.3% vs. 77.5%; $p = 0.04$) in the first month than the GC control group. However, no similar significant difference was found in the third month ($p > 0.05$). One month after discharge, the GC intervention group showed less weight loss (–0.75 (–3.00, 0.50) kg vs. –2.75 (–4.50, –1.00) kg; Z = –2.31, $p = 0.02$), less BMI decrease (–0.29 (–1.20, 0.20) kg/m^2 vs. –0.97 (–1.64, –0.39) kg/m^2; Z = –2.32, $p = 0.02$), increased albumin levels (7.25 (6.25, 9.85) g/L vs. 4.90 (3.15, 9.00) g/L; Z = –2.20, $p = 0.03$), increased handgrip strength (3.20 (2.25, 4.18) kg vs. 0.50 (–0.35, 1.30) kg; Z = –6.35, $p < 0.01$), and a lower prevalence of GLIM-defined malnutrition (56.3% vs. 77.5%; $p = 0.04$) than the GC control group. Three months after discharge, compared to the GC control group, the GC

intervention group had less weight loss (0.25 (–2.88, 2.50) kg vs. –3.00 (–3.50, 0.13) kg; Z = –2.53, p = 0.01), less BMI decrease (0.08 (–1.13, 0.95) kg/m^2 vs. –1.04 (–1.34, 0.04) kg/m^2; Z = –2.48, p = 0.01) and increased handgrip strength (4.85 (2.08, 5.85) kg vs. 1.05 (–0.23, 1.93) kg; Z = –5.62, p < 0.01). We also analysed subgroups of distal GC. No significant differences in baseline characteristics between the intervention and control groups at discharge after gastrectomy was observed. One month after discharge, the intervention group showed less weight loss (–0.50 (–3.00, 0.50) kg vs. –3.00 (–4.63, –1.38) kg; Z = –2.72, p = 0.006), and increased handgrip strength (3.50 (2.40, 4.30) kg vs. 0.50 (–0.13, 1.30) kg; Z = –6.35, p < 0.01) than the control group. Three months after discharge, the intervention group showed increased handgrip strength (5.00 (2.70, 6.30) kg vs. 1.05 (–0.10, 1.98) kg; Z = –5.15, p < 0.01) than the control group. In addition, in the first and third months after discharge, the CC intervention group showed a greater increase in handgrip strength than the CC control group (1st Month: 4.50 (2.93, 5.53) kg vs. 1.10 (0.10, 2.10) kg, Z = –4.98, p < 0.01; 3rd Month: 5.80 (4.70, 8.60) kg vs. 1.55 (0.00, 2.58) kg, Z = –4.98, p < 0.01). When combining GC and CC, the intervention group experienced less weight loss (1st Month: –1.00 (–2.38, 0.50) kg vs. –2.00 (–4.00, 0.00) kg; Z = –2.73, p = 0.006; 3rd Month: 0.50 (–2.00, 2.00) kg vs. –1.50 (–3.50, 0.50) kg; Z = –3.20, p = 0.001), less BMI decrease (1st Month: –0.35 (–0.95, 0.19) kg/m^2 vs. –0.81 (–1.52, 0.00) kg/m^2; Z = –2.62, p = 0.009; 3rd Month: 0.19 (–0.73, 0.63) kg/m^2 vs. –0.58 (–1.24, 0.17) kg/m^2; Z = –3.19, p = 0.001), and increased handgrip strength (1st Month: 3.70 (2.40, 4.58) kg vs. 0.80 (–0.20, 1.50) kg; Z = –7.92, p < 0.01; 3rd Month: 5.30 (3.50, 6.80) kg vs. 1.10 (0.00, 2.08) kg; Z = –7.37, p < 0.01) than the control group in the first and third months after discharge (Table 3a,3b). Among GC and CC patients who were discharged without malnutrition according to the GLIM criteria, 57.5% of patients in the control group were diagnosed with malnutrition 1 month after discharge according to the GLIM criteria, whereas only 27.7% of patients in the intervention group were diagnosed with malnutrition 1 month after discharge according to the GLIM criteria, with a statistically significant difference (X^2 = 7.93, p = 0.005).

3.2 Quality of Life

Based on 3 months of observation, it was found that the quality of life of the intervention groups improved more than that of the control groups over time. Regardless of GC or CC, the functional dimensions and symptom dimensions of the intervention groups were better than those of the control groups. The advantages of intervention groups were more significant in the third month than in the first month. One month after discharge, the GC intervention group showed better physical (86.7 (80.0, 93.3) vs. 80.0 (73.3, 91.7); Z = –2.45, p = 0.01), role (83.3 (70.8, 100) vs. 66.7 (66.7, 83.3); Z = –2.75, p = 0.01), and social functions (83.3 (83.3, 100) vs. 83.3 (66.7, 83.3); Z = –2.96, p = 0.003), and appetite (appetite loss 0.00 (0.00, 0.00) vs. 0.00 (0.00, 33.3); Z = –2.55, p = 0.01) than those of the GC control group. 3 months after discharge, the GC intervention group had better physical (93.3 (86.7, 93.3) vs. 86.7 (73.3, 93.3); Z = –2.50, p = 0.01), role (83.3 (70.8, 100) vs. 66.7 (66.7, 83.3); Z = –2.55, p = 0.01), and social functions (100 (83.3, 100) vs. 83.3 (66.7, 83.3); Z = –3.88, p < 0.01) than those of the GC control group, whereas appetite loss symptoms (0.00 (0.00, 0.00) vs. 0.00 (0.00, 33.3); Z = –2.86, p = 0.004) was milder than those of the GC control group. We also analysed subgroups of distal GC. There were no significant differences in baseline characteristics between the intervention and control groups at discharge after gastrectomy. The intervention group showed better role (1st Month: 83.3 (83.3, 100) vs. 83.3 (66.7, 83.3); Z = –2.46, p = 0.01; 3rd Month: 83.3 (83.3, 100) vs. 83.3 (66.7, 83.3); Z = –2.22, p = 0.03), and social functions (1st Month: 83.3 (83.3, 100) vs. 83.3 (66.7, 83.3); Z = –2.31, p = 0.02; 3rd Month: 100 (83.3, 100) vs. 83.3 (70.8, 83.3); Z = –3.39, p = 0.001), and appetite (1st Month: 0.00 (0.00, 0.00) vs. 0.00 (0.00, 33.3); Z = –2.35, p = 0.02; 3rd Month: 0.00 (0.00, 0.00) vs. 0.00 (0.00, 33.3); Z = –2.49, p = 0.01) than those of the control group in the first and third months after discharge (p < 0.05). Similar results were obtained for the CC. The CC intervention group showed better physical, role, and social functions, and appetite than those of the CC control group in the first month (p < 0.05), and better overall health status, physical, role, cognitive, and social functions than those of the CC control group in the third month (p < 0.05), while appetite loss symptoms were milder than those of the CC control group in the third month (p < 0.05), as shown in Table 4a,4b. When combining GC and CC, the intervention group had better physical function, role function, social function, and appetite than those of the control group in the first month (p < 0.05), and better overall health status, physical, role, cognitive, and social functions than those of the control group in the third month (p < 0.05), while fatigue and appetite loss symptoms were milder than those of the control group in the third month (p < 0.05) (Table 4a,4b).

4. Discussion

4.1 Practical Challenges and Needs for Post-Discharge Management

Unlike the comprehensive medical care received during hospitalisation, patients lose access to professional care after discharged. Although patients and their families have a greater need for knowledge of nutritional rehabilitation after discharge [17,18], this need often remains unmet. Postoperatively discharged patients often face constraints due to insufficient self-management skills and inadequate familial nutritional support [19]. These factors disturb home nutrition management, consequently increasing the risk of malnutrition [20]. Thus, discharged patients require regu-

Table 3a. Nutritional indices of the participants during the follow-up period.

Variables	GI (1M n = 48, 3M n = 40)	GC (1M n = 40, 3M n = 34)	CI (1M n = 24, 3M n = 19)	CC (1M n = 27, 3M n = 22)	GI vs. GC Z/X^2, *p*	CI vs. CC Z/X^2, *p*	AI (1M n = 72, 3M n = 59)	AC (1M n = 67, 3M n = 56)	AI vs. AC Z/X^2, *p*
Malnutrition diagnosed per GLIM criteria									
-/+ (1M)	21/27	9/31	16/8	9/18	X^2 = 4.39, df = 1, *p* = 0.04	X^2 = 5.65, df = 1, *p* = 0.02	37/35	18/49	X^2 = 8.73, df = 1, *p* = 0.003
-/+ (3M)	21/19	11/23	16/3	10/12	X^2 = 3.04, df = 1, *p* = 0.08	X^2 = 6.60, df = 1, *p* = 0.01	37/22	21/35	X^2 = 7.31, df = 1, *p* = 0.007
Body weight (kg) (1M)	57.0 (47.9, 66.0)	56.3 (50.0, 61.6)	53.8 (48.3, 60.0)	58.0 (51.0, 63.0)	Z = –0.16, 0.88	Z = –1.20, 0.23	55.8 (48.3, 63.4)	57.0 (50.0, 62.0)	Z = –0.55, 0.58
Variation of body weight (kg) (compared to discharge) (1M)	–0.75 (–3.00, 0.50)	–2.75 (–4.50, –1.00)	–1.00 (–1.00, 0.50)	–2.00 (–3.00, 0.50)	Z = –2.31, 0.02	Z = –1.53, 0.13	–1.00 (–2.38, 0.50)	–2.00 (–4.00, 0.00)	Z = –2.73, 0.006
Body weight (kg) (3M)	56.5 (48.6, 65.0)	56.3 (50.9, 61.5)	52.0 (48.0, 61.0)	60.8 (54.3, 66.8)	Z = –0.06, 0.95	Z = –1.86, 0.06	56.0 (48.5, 64.0)	58.5 (52.1, 63.8)	Z = –1.05, 0.29
Variation of body weight (kg) (compared to discharge) (3M)	0.25 (–2.88, 2.50)	–3.00 (–3.50, 0.13)	0.50 (–1.00, 1.50)	–0.75 (–3.00, 1.00)	Z = –2.53, 0.01	Z = –1.88, 0.06	0.50 (–2.00, 2.00)	–1.50 (–3.50, 0.50)	Z = –3.20, 0.001
BMI (kg/m^2) (1M)	20.6 (19.4, 22.8)	20.3 (19.1, 23.2)	20.4 (19.6, 23.9)	21.8 (18.4, 24.4)	Z = –0.48, 0.63	Z = –0.58, 0.57	20.5 (19.5, 22.8)	20.8 (19.1, 23.6)	Z = –0.09, 0.93
Variation of BMI (kg/m^2) (compared to discharge) (1M)	–0.29 (–1.20, 0.20)	–0.97 (–1.64, –0.39)	–0.35 (–0.47, 0.19)	–0.70 (–1.10, 0.15)	Z = –2.32, 0.02	Z = –1.44, 0.15	–0.35 (–0.95, 0.19)	–0.81 (–1.52, 0.00)	Z = –2.62, 0.009
BMI (kg/m^2) (3M)	21.0 (19.1, 23.3)	20.2 (19.3, 23.2)	20.9 (20.1, 21.7)	22.3 (19.4, 25.1)	Z = –0.68, 0.49	Z = –0.86, 0.39	20.9 (19.7, 23.2)	20.7 (19.3, 24.0)	Z = –0.04, 0.97
Variation of BMI (kg/m^2) (compared to discharge) (3M)	0.08 (–1.13, 0.95)	–1.04 (–1.34, 0.04)	0.23 (–0.37, 0.59)	–0.27 (–1.06, 0.34)	Z = –2.48, 0.01	Z = –1.94, 0.05	0.19 (–0.73, 0.63)	–0.58 (–1.24, 0.17)	Z = –3.19, 0.001

Note: 1M, 1st month; 3M, 3rd month.

Table 3b. Nutritional indices of the participants during the follow-up period.

Variables	GI (1M n = 48, 3M n = 40)	GC (1M n = 40, 3M n = 34)	CI (1M n = 24, 3M n = 19)	CC (1M n = 27, 3M n = 22)	GI vs. GC Z, *p*	CI vs. CC Z, *p*	AI (1M n = 72, 3M n = 59)	AC (1M n = 67, 3M n = 56)	AI vs. AC Z, *p*
Handgrip strength (kg) (1M)	32.1 (26.9, 35.5)	27.6 (23.2, 34.1)	30.3 (23.6, 37.7)	27.6 (20.2, 36.0)	Z = –2.09, 0.04	Z = –1.36, 0.17	31.7 (25.7, 35.9)	27.6 (22.4, 34.7)	Z = –2.35, 0.02
Variation of handgrip strength (kg) (compared to discharge) (1M)	3.20 (2.25, 4.18)	0.50 (–0.35, 1.30)	4.50 (2.93, 5.53)	1.10 (0.10, 2.10)	Z = –6.35, <0.001	Z = –4.98, <0.001	3.70 (2.40, 4.58)	0.80 (–0.20, 1.50)	Z = –7.92, <0.001
Handgrip strength (kg) (3M)	34.7 (29.1, 37.1)	28.3 (24.2, 34.2)	31.4 (24.8, 39.0)	29.1 (22.3, 37.4)	Z = –2.97, 0.003	Z = –1.11, 0.27	34.6 (28.3, 37.1)	29.0 (24.1, 35.6)	Z = –2.84, 0.004
Variation of handgrip strength (kg) (compared to discharge) (3M)	4.85 (2.08, 5.85)	1.05 (–0.23, 1.93)	5.80 (4.70, 8.60)	1.55 (0.00, 2.58)	Z = –5.62, <0.001	Z = –4.98, <0.001	5.30 (3.50, 6.80)	1.10 (0.00, 2.08)	Z = –7.37, <0.001
Albumin (g/L) (1M)	39.4 (36.1, 41.0)	37.5 (33.8, 39.6)	39.8 (35.3, 42.1)	39.9 (38.2, 42.1)	Z = –1.74, 0.08	Z = –0.76, 0.45	39.8 (35.9, 41.2)	39.0 (36.5, 41.3)	Z = –0.21, 0.83
Variation of albumin (g/L) (compared to discharge) (1M)	7.25 (6.25, 9.85)	4.90 (3.15, 9.00)	7.80 (3.50, 8.45)	7.35 (4.63, 8.93)	Z = –2.20, 0.03	Z = –0.07, 0.94	7.30 (5.25, 9.55)	5.90 (4.35, 8.85)	Z = –1.66, 0.10
Albumin (g/L) (3M)	39.5 (35.7, 42.7)	38.9 (34.5, 40.2)	40.7 (38.7, 42.7)	39.9 (37.3, 41.8)	Z = –0.91, 0.36	Z = –0.75, 0.45	40.4 (36.9, 42.6)	39.0 (36.0, 40.7)	Z = –1.15, 0.25
Variation of albumin (g/L) (compared to discharge) (3M)	6.75 (4.35, 12.10)	6.80 (3.00, 12.10)	8.00 (6.70, 8.90)	4.70 (1.00, 8.33)	Z = –0.11, 0.92	Z = –1.87, 0.06	7.70 (4.75, 9.65)	6.70 (1.10, 9.90)	Z = –1.11, 0.27
Hemoglobin (g/L) (1M)	107 (102, 122)	114 (99.5, 123)	112 (100, 124)	120 (112, 127)	Z = –0.38, 0.71	Z = –1.29, 0.20	109 (101, 124)	117 (104, 125)	Z = –1.26, 0.21
Variation of hemoglobin (g/L) (compared to discharge) (1M)	12.00 (2.50, 21.50)	9.00 (1.75, 15.30)	5.00 (–4.75, 18.50)	12.00 (4.75, 17.50)	Z = –1.18, 0.24	Z = –1.49, 0.14	9.00 (1.00, 21.00)	9.50 (3.75, 16.00)	Z = –0.12, 0.91
Hemoglobin (g/L) (3M)	113.0 (99.3, 126.0)	117.0 (102.0, 120.0)	127.0 (104.0, 134.0)	127.0 (122.0, 141.0)	Z = –0.16, 0.88	Z = –1.08, 0.28	118.0 (100.0, 131.0)	120.0 (114.0, 132.0)	Z = –0.90, 0.37
Variation of hemoglobin (g/L) (compared to discharge) (3M)	3.50 (–5.75, 25.80)	8.00 (–9.00, 14.00)	15.50 (7.25, 24.00)	15.50 (9.50, 24.80)	Z = –0.07, 0.94	Z = –0.28, 0.78	10.00 (–1.50, 25.00)	11.00 (–2.00, 24.00)	Z = –0.05, 0.96

Table 4a. EORTC QLQ-C30 scores of the participants during the follow-up period.

Variables	GI (1M n = 48, 3M n = 40)	GC (1M n = 40, 3M n = 34)	CI (1M n = 24, 3M n = 19)	CC (1M n = 27, 3M n = 22)	GI vs. GC Z, *p*	CI vs. CC Z, *p*	AI (1M n = 72, 3M n = 59)	AC (1M n = 67, 3M n = 56)	AI vs. AC Z, *p*
Global health and QOL scale (1M)	58.3 (43.8, 66.7)	58.3 (41.7, 66.7)	66.7 (58.3, 75.0)	66.7 (58.3, 75.0)	Z = –1.12, 0.26	Z = –0.64, 0.52	58.3 (50.0, 75.0)	58.3 (50.0, 66.7)	Z = –0.79, 0.43
Global health and QOL scale (3M)	58.3 (50.0, 75.0)	50.0 (41.7, 66.7)	75.0 (66.7, 75.0)	66.7 (56.3, 75.0)	Z = –1.93, 0.05	Z = –2.14, 0.03	66.7 (50.0, 75.0)	58.3 (50.0, 72.9)	Z = –2.30, 0.02
Physical functioning (1M)	86.7 (80.0, 93.3)	80.0 (73.3, 91.7)	90.0 (86.7, 100)	86.7 (73.3, 93.3)	Z = –2.45, 0.01	Z = –2.41, 0.02	86.7 (86.7, 93.3)	80.0 (73.3, 93.3)	Z = –3.23, 0.001
Physical functioning (3M)	93.3 (86.7, 93.3)	86.7 (73.3, 93.3)	93.3 (86.7, 100)	86.7 (80.0, 93.3)	Z = –2.50, 0.01	Z = –2.63, 0.01	93.3 (86.7, 100)	86.7 (73.3, 93.3)	Z = –3.55, <0.001
Role functioning (1M)	83.3 (70.8, 100)	66.7 (66.7, 83.3)	91.7 (83.3, 100)	83.3 (66.7, 83.3)	Z = –2.75, 0.01	Z = –2.52, 0.01	83.3 (83.3, 100)	83.3 (66.7, 83.3)	Z = –3.60, <0.001
Role functioning (3M)	83.3 (70.8, 100)	66.7 (66.7, 83.3)	83.3 (83.3, 100)	83.3 (66.7, 83.3)	Z = –2.55, 0.01	Z = –2.76, 0.01	83.3 (83.3, 100)	83.3 (66.7, 83.3)	Z = –3.49, <0.001
Emotional functioning (1M)	91.7 (83.3, 100)	91.7 (75.0, 100)	83.3 (77.1, 97.9)	91.7 (83.3, 91.7)	Z = –0.07, 0.95	Z = –0.18, 0.85	91.7 (83.3, 100)	91.7 (75.0, 100)	Z = –0.10, 0.92
Emotional functioning (3M)	91.7 (85.4, 100)	91.7 (81.3, 100)	91.7 (83.3, 100)	91.7 (83.3, 93.8)	Z = –1.09, 0.28	Z = –0.21, 0.84	91.7 (83.3, 100)	91.7 (83.3, 100)	Z = –1.14, 0.25
Cognitive functioning (1M)	83.3 (83.3, 100)	83.3 (83.3, 83.3)	83.3 (83.3, 100)	83.3 (83.3, 100)	Z = –1.28, 0.20	Z = –1.16, 0.25	83.3 (83.3, 100)	83.3 (83.3, 83.3)	Z = –1.67, 0.10
Cognitive functioning (3M)	100 (83.3, 100)	83.3 (83.3, 100)	100 (83.3, 100)	83.3 (83.3, 87.5)	Z = –1.94, 0.05	Z = –2.44, 0.02	100 (83.3, 100)	83.3 (83.3, 100)	Z = –3.03, 0.002
Social functioning (1M)	83.3 (83.3, 100)	83.3 (66.7, 83.3)	91.7 (83.3, 100)	83.3 (66.7, 83.3)	Z = –2.96, 0.003	Z = –2.76, 0.006	83.3 (83.3, 100)	83.3 (66.7, 83.3)	Z = –3.94, <0.001
Social functioning (3M)	100 (83.3, 100)	83.3 (66.7, 83.3)	83.3 (83.3, 100)	83.3 (83.3, 83.3)	Z = –3.88, <0.001	Z = –2.50, 0.01	100 (83.3, 100)	83.3 (66.7, 83.3)	Z = –4.63, <0.001

Table 4b. EORTC QLQ-C30 scores of the participants during the follow-up period.

Variables	GI (1M n = 48, 3M n = 40)	GC (1M n = 40, 3M n = 34)	CI (1M n = 24, 3M n = 19)	CC (1M n = 27, 3M n = 22)	GI vs. GC Z, *p*	CI vs. CC Z, *p*	AI (1M n = 72, 3M n = 59)	AC (1M n = 67, 3M n = 56)	AI vs. AC Z, *p*
Fatigue (1M)	22.2 (11.1, 22.2)	22.2 (11.1, 33.3)	22.2 (11.1, 22.2)	22.2 (11.1, 33.3)	Z = –0.63, 0.53	Z = –0.77, 0.44	22.2 (11.1, 22.2)	22.2 (11.1, 33.3)	Z = –1.07, 0.29
Fatigue (3M)	11.1 (0.00, 22.2)	22.2 (0.00, 33.3)	11.1 (0.00, 22.2)	22.2 (11.1, 33.3)	Z = –1.85, 0.06	Z = –1.91, 0.06	11.1 (0.00, 22.2)	22.2 (0.00, 33.3)	Z = –2.63, 0.008
Pain (1M)	16.7 (0.00, 33.3)	16.7 (0.00, 33.3)	16.7 (0.00, 16.7)	16.7 (0.00, 33.3)	Z = –0.44, 0.66	Z = –0.05, 0.96	16.7 (0.00, 33.3)	16.7 (0.00, 33.3)	Z = –0.38, 0.71
Pain (3M)	0.00 (0.00, 33.3)	16.7 (0.00, 33.3)	0.00 (0.00, 16.7)	8.33 (0.00, 33.3)	Z = –1.23, 0.22	Z = –0.65, 0.52	0.00 (0.00, 33.3)	16.7 (0.00, 33.3)	Z = –1.36, 0.17
Nausea and vomiting (1M)	0.00 (0.00, 16.7)	0.00 (0.00, 16.7)	8.33 (0.00, 16.7)	16.7 (0.00, 16.7)	Z = –0.41, 0.68	Z = –0.61, 0.54	0.00 (0.00, 16.7)	0.00 (0.00, 16.7)	Z = –0.87, 0.39
Nausea and vomiting (3M)	0.00 (0.00, 12.5)	0.00 (0.00, 16.7)	0.00 (0.00, 16.7)	0.00 (0.00, 16.7)	Z = –1.07, 0.29	Z = –0.20, 0.84	0.00 (0.00, 16.7)	0.00 (0.00, 16.7)	Z = –1.05, 0.30
Dyspnoea (1M)	0.00 (0.00, 33.3)	0.00 (0.00, 33.3)	0.00 (0.00, 33.3)	0.00 (0.00, 33.3)	Z = –0.23, 0.82	Z = –0.01, 0.99	0.00 (0.00, 33.3)	0.00 (0.00, 33.3)	Z = –0.21, 0.84
Dyspnoea (3M)	0.00 (0.00, 33.3)	0.00 (0.00, 33.3)	0.00 (0.00, 33.3)	0.00 (0.00, 33.3)	Z = –0.77, 0.44	Z = –0.32, 0.75	0.00 (0.00, 33.3)	0.00 (0.00, 33.3)	Z = –0.79, 0.43
Insomnia (1M)	0.00 (0.00, 33.3)	0.00 (0.00, 33.3)	33.3 (0.00, 33.3)	33.3 (0.00, 33.3)	Z = –0.70, 0.48	Z = –0.63, 0.53	0.00 (0.00, 33.3)	33.3 (0.00, 33.3)	Z = –0.99, 0.32
Insomnia (3M)	0.00 (0.00, 33.3)	16.7 (0.00, 33.3)	0.00 (0.00, 33.3)	0.00 (0.00, 33.3)	Z = –0.45, 0.65	Z = –0.40, 0.69	0.00 (0.00, 33.3)	0.00 (0.00, 33.3)	Z = –0.51, 0.61
Appetite loss (1M)	0.00 (0.00, 0.00)	0.00 (0.00, 33.3)	0.00 (0.00, 0.00)	0.00 (0.00, 33.3)	Z = –2.55, 0.01	Z = –2.36, 0.02	0.00 (0.00, 0.00)	0.00 (0.00, 33.3)	Z = –3.46, 0.001
Appetite loss (3M)	0.00 (0.00, 0.00)	0.00 (0.00, 33.3)	0.00 (0.00, 0.00)	0.00 (0.00, 33.3)	Z = –2.86, 0.004	Z = –2.16, 0.03	0.00 (0.00, 0.00)	0.00 (0.00, 33.3)	Z = –3.59, <0.001
Constipation (1M)	0.00 (0.00, 25.0)	0.00 (0.00, 25.0)	0.00 (0.00, 33.3)	0.00 (0.00, 33.3)	Z = –0.09, 0.93	Z = –0.24, 0.81	0.00 (0.00, 33.3)	0.00 (0.00, 33.3)	Z = –0.04, 0.97
Constipation (3M)	0.00 (0.00, 33.3)	0.00 (0.00, 33.3)	0.00 (0.00, 33.3)	0.00 (0.00, 33.3)	Z = –0.12, 0.90	Z = –0.26, 0.79	0.00 (0.00, 33.3)	0.00 (0.00, 33.3)	Z = –0.32, 0.75
Diarrhoea (1M)	0.00 (0.00, 0.00)	0.00 (0.00, 0.00)	0.00 (0.00, 25.0)	0.00 (0.00, 33.3)	Z = –0.41, 0.68	Z = –1.15, 0.25	0.00 (0.00, 0.00)	0.00 (0.00, 33.3)	Z = –1.23, 0.22
Diarrhoea (3M)	0.00 (0.00, 0.00)	0.00 (0.00, 8.33)	0.00 (0.00, 0.00)	0.00 (0.00, 33.3)	Z = –0.97, 0.33	Z = –1.33, 0.18	0.00 (0.00, 0.00)	0.00 (0.00, 25.0)	Z = –1.58, 0.11
Financial difficulties (1M)	0.00 (0.00, 33.3)	0.00 (0.00, 33.3)	33.3 (0.00, 33.3)	0.00 (0.00, 33.3)	Z = –0.17, 0.87	Z = –0.40, 0.69	16.7 (0.0, 33.3)	0.00 (0.00, 33.3)	Z = –0.37, 0.71
Financial difficulties (3M)	0.00 (0.00, 33.3)	0.00 (0.00, 33.3)	0.00 (0.00, 33.3)	0.00 (0.00, 33.3)	Z = –0.25, 0.81	Z = –0.37, 0.71	0.00 (0.00, 33.3)	0.00 (0.00, 33.3)	Z = –0.39, 0.70

lar screening for malnutrition [21,22]. Currently, most discharge education is presented verbally to postoperative patients [23]. The quality of discharge education for postoperative patients is low owing to insufficient time and a single form [24]. Actually, effective post-discharge education is essential for patient participation in home-based postoperative care [25,26]. To achieve better supervision and efficient management of discharged patients, it is necessary to coordinate connections among patients, family members, and physicians through health managers, thereby establishing a malnutrition-monitoring framework with four distinct roles. As a continued service of pre- and intra-consultation management, post-discharge management should be implemented by multidisciplinary teams. Our post-discharge management team comprised gastroenterology oncology specialists, special nurses, clinical nutritionists, exercise rehabilitation therapists, psychological counsellors and health managers, providing professional post-discharge management services to postoperatively discharged patients.

4.2 Details of Standardized Post-Discharge Management

Qualified post-discharge management should be based on patients' needs and provide various knowledge at different stages, including scientific dietary guidance, appetite stimulation techniques, reasonable exercise therapy, prevention and treatment of complications, and comprehensive therapy, etc. It cultivates patients' self-care and postoperative rehabilitation awareness through diverse forms and comprehensive content. A critical measure for monitoring post-discharge malnutrition is the implementation of follow-up management [27]. Compared with tedious verbal education at discharge, post-discharge management is easier for people to accept. In addition to passive follow-ups in outpatient clinics, health managers conducted regular proactive follow-ups with patients. The post-discharge management team provides question and answer (Q&A) services to patients and eliminates their doubts. Professionally trained health managers can patiently and meticulously enquire about patients' nutritional status via phone calls as part of the malnutrition screening. If necessary, they can facilitate direct communication between patients and nutritionists for Q&A sessions, thereby enabling precise nutritional management.

4.3 Post-Discharge Management Improves Nutritional Status

To effectively monitor nutritional status, we selected six representative parameters: GLIM criteria, body weight, BMI, handgrip strength, albumin, and haemoglobin. Handgrip strength is one of the representations which is a simple and convenient method for evaluating muscle strength [28,29,30]. A positive longitudinal association between the handgrip strength and the nutritional status has been previously reported [31]. In addition, prealbumin was omitted because of its short metabolic cycle [32], whereas total protein was omitted because of its susceptibility to influences. Based on 3 months of observation, the nutritional variables of the intervention groups significantly improved compared to those of the control groups 1 month after discharge, especially for GC. No new significant differences were observed between them at the third month of follow-up. Compared to the GC control group, the GC intervention group had a higher albumin increase and a lower incidence of GLIM-defined malnutrition in the first month ($p < 0.05$), but no similar significant difference was found in the third month. Compared to the GC control group, the GC intervention group had less weight loss, less BMI decrease, increased albumin level, increased handgrip strength, and a lower incidence of GLIM-defined malnutrition 1 month after discharge ($p < 0.05$). Less weight loss, lower BMI decrease, and increased handgrip strength 3 months after discharge ($p < 0.05$). Similar conclusions were drawn when conducting subgroup analysis of distal GC or combined analysis of GC and CC. One possible reason for this is that patients with GC in the early postoperative period relied more on post-discharge management and showed better compliance. With improvements in physical fitness and gradual unbanning of diet, patients' compliance with post-discharge management in the late postoperative period is not as good as before. In fact, improvements in nutritional status rely primarily on dietary intake. Peak inflammation subsides one month after surgery, and intestinal function is largely restored. With professional nutritional guidance for post-discharge management, nutritional recovery proceeds rapidly, with relevant parameters generally returning to normal within one month postoperatively [33,34]. Moreover, both the GC and CC intervention groups showed steady growth in handgrip strength when compared with the control groups, which reflects that post-discharge management can improve patients' self-care abilities to some extent.

4.4 Post-Discharge Management Improves Quality of Life

EORTC QLQ-C30 scale has been widely used to evaluate quality of life of patients with various cancers. The scale has demonstrated satisfactory reliability and validity [35,36]. Therefore, the EORTC QLQ-C30 scale was used to assess the quality of life of the participants in this study. Based on three months of observation, the quality of life of the intervention groups improved better than that of the control groups over time. Regardless of GC or CC, the functional dimensions and symptom dimensions of the intervention groups were better than those of the control groups. The advantages of intervention groups were more significant in the third month than those of the first month. Both GC and CC presented as follows: compared to control groups, intervention groups showed better physical, role, and social functions and appetite 1 and 3 months after discharge ($p < 0.05$). Similar conclusions were drawn when conducting subgroup analysis of distal GC or combined analysis of GC and CC. Delayed improvement in the quality of life is related to its nature as a comprehensive system that

covers both physical and mental aspects. It encompasses a wider range of dimensions than nutritional status. Overall improvement usually requires gradual adjustment and reconstruction of the body and mind after physical recovery, along with a period of adaptation [37,38]. In summary, patients improved their cognition and changed their lifestyles under post-discharge management. Thus, the quality of life gradually improved.

4.5 Strengths and Limitations

This prospective randomised controlled trial revealed the beneficial effects of post-discharge management on the nutritional status and quality of life of patients with GC or CC after surgery. Finally, regardless of GC or CC, post-discharge management improved nutritional status and quality of life of the postoperative patients. One intriguing observation is the time-varying pattern of outcomes, whereby nutritional effects peak at one month and quality of life improves most noticeably at three months. Apart from its practical roles in improving malnutrition status and quality of life, as mentioned above, post-discharge management also plays a role in preventing the occurrence of malnutrition in patients with GC and CC. In this study, among all GC and CC discharged patients without a malnutrition diagnosis, 57.5% of the cases in the control group were diagnosed with malnutrition 1 month after discharge according to the GLIM criteria, while only 27.7% of the cases in the intervention group were diagnosed with malnutrition 1 month after discharge according to the GLIM criteria, with a statistically significant difference ($p = 0.005$). Thus, post-discharge management can effectively reduce the incidence of malnutrition in potentially malnourished individuals through nutritional guidance.

Despite these important findings, this study has several limitations. First, this was a single-centre rather than multicentre study. Second, the number of CC patients at the 3rd Month is relatively small, which may limit the statistical power and increase the risk of unstable estimates. Third, given that outcome information of patients lost to follow-up was unavailable, this may be a potential source of bias. In the future, we will initiate a multicentre study and use wearable remote monitoring devices to investigate the clinical value of post-discharge management in the postoperative rehabilitation of patients with GC or CC.

5. Conclusions

Regardless of whether GC or CC group, post-discharge management improves the nutritional status and quality of life of postoperative patients. The nutritional status of the intervention groups significantly improved compared to that of the control groups 1 month after discharge, especially for the GC group. No new significant differences were observed between the groups at the 3-month follow-up. In addition, the quality of life of the intervention groups improved more than that of the control groups over time. Regardless of GC or CC, the functional dimensions and symptom dimensions of the intervention groups were better than those of the control groups. The advantages of the intervention groups were more significant in the third month than in the first month. Patients had improved cognition and changed their lifestyle after the post-discharge management. Hence, the patient's quality of life gradually improved. Moreover, apart from the practical role in improving malnutrition status and quality of life as mentioned above, post-discharge management also played a role in preventing the occurrence of malnutrition.

Availability of Data and Materials

The datasets supporting this study's findings are available from the corresponding author.

Author Contributions

WW designed the research study and drafted the initial manuscript. QZ, FL, CZ and ZZ performed the study. ZZ was responsible for data collection. KC analyzed the data. QZ, FL, CZ and MZ contributed to the interpretation of data once the trial was completed. MZ supervised the research. All authors contributed to manuscript revision and editing. WW provided funding acquisition and resources. All authors read and approved the final manuscript. All authors have participated sufficiently in the work and agreed to be accountable for all aspects of the work.

Ethics Approval and Consent to Participate

This study is a prospective clinical trial which has been registered at https://www.chictr.org.cn. (ChiCTR2400084776). The approval of Academic Ethics Committee of Shaoxing People's Hospital/The first affiliated hospital, Shaoxing University (Ethics Clearance No.2024-YL037-01) was received. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all individual participants included in this study.

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Conflicts of Interest

The authors declare no conflicts of interest.

Declaration of AI and AI-Assisted Technologies in the Writing Process

The authors utilized DeepSeek V3 for scientific English language editing to improve the clarity and grammar of this manuscript. Following AI-assisted editing, the authors thoroughly reviewed and edited the content as needed and take full responsibility for the published work.

Supplementary Material

Supplementary material associated with this article can be found, in the online version, at https://doi.org/10.31083/IJVNR51071.

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