RESEARCH ARTICLE

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Identification of Malnutrition Risk Factors in Gastrointestinal Cancer: A Multicentric Cross-Sectional Study

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Abstract

Background: Malnutrition is highly prevalent among gastrointestinal (GI) cancer patients and is associated with poor clinical outcomes. Early identification of nutritional risk is essential to optimize patient care prior to treatment initiation. **Objective:** To assess the prevalence of malnutrition using Patient-Generated Subjective Global Assessment (PG-SGA) and examine its association with demographic, clinical, anthropometric, and dietary intake as risk factors in newly diagnosed, treatment naïve GI cancer patients. **Methods:** A cross-sectional study was conducted in Coimbatore, Tamil Nadu, involving 181 patients. Nutritional status was assessed using PG SGA, anthropometry, and a 3-day 24-hour dietary recall. Statistical analysis included Chi-square, ANOVA and logistic regression. **Results:** Malnutrition was identified in 73.5% of patients. Significant associations were found between malnutrition and stage of cancer ($p < 0.001$), tumour site ($p=0.001$), symptom burden ($p < 0.001$), and increased nutritional needs ($p < 0.001$). Malnourished patients had significantly lower energy and protein intake ($p < 0.001$). Independent predictors of malnutrition included low BMI (OR: 0.509, 95% CI: 0.335-0.773, $p=0.002$), weight loss percentage in six months (OR; 3.019, 95% CI: 1.509-6.039, $p=0.002$), inadequate energy intake (OR=23.036, 95% CI: 7.304-72.654, $p<0.001$) and protein intake (OR=49.029, 95% CI: 6.200-87.69, $p<0.001$), symptom burden (OR: 0.162, 95% CI: 0.090-0.244, $p<0.001$), increased nutritional needs (OR: 0.301, 95% CI: 0.238-0.380, $p<0.001$), advanced stage of cancer (OR=0.550, 95% CI: 0.478-0.634, $p<0.001$). **Conclusion:** A high prevalence of malnutrition was found among newly diagnosed GI cancer patients, driven by both clinical and nutritional factors. Early assessment and targeted intervention, especially focusing on dietary intake and symptom management, are crucial to improve clinical outcomes.

Keywords: Gastrointestinal cancer- Nutritional assessment- PG SGA- Malnutrition- Risk factors

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Introduction

Cancer remains a major global health concern, accounting for millions of deaths each year. Among various cancer types, gastrointestinal (GI) cancers, which include malignancies of the esophagus, stomach, liver, pancreas, gallbladder, colon, and rectum, represent a substantial portion of the global cancer burden [1]. According to the Globocan 2024 data, GI cancers are among the top causes of cancer-associated mortality, with stomach cancer alone responsible for approximately 969,000 new cases and 660,000 deaths annually, making it the fifth most commonly diagnosed cancer and the third leading cause of cancer mortality worldwide [2]. The burden of GI cancers is especially pronounced in low and middle-income countries, with Asia bearing over 60% of new cases and deaths [3]. In India, the incidence is steadily rising, particularly for colorectal and esophageal cancers, while stomach and liver cancers have the highest mortality [4].

One of the most underrecognised yet critical complications in GI cancer patients is malnutrition. Research indicates that malnutrition affects anywhere from 15-87 % of cancer patients, with those suffering from GI malignancies being at heightened risk due to factors like tumour-related obstruction, nutrient malabsorption, and cancer-induced cachexia [5]. Upper GI cancers pose an even greater threat, with studies reporting that up to 22 % of patients are severely malnourished and 63% are moderately malnourished. Lower GI cancers also present a significant risk, with 10-17 % of patients experiencing severe malnutrition and 25-60 % classified as moderately malnourished [6].

Malnutrition has profound implications, including reduced treatment tolerance, prolonged hospitalization, increased infections, impaired quality of life, and mortality. Alarmingly, around 20 % of cancer-related deaths are attributed to malnutrition rather than the malignancy itself [7]. The causes of malnutrition are multifactorial, ranging from tumour site and stage to symptoms like vomiting, nausea, dysphagia, as well as inadequate nutrition support and limited awareness among

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healthcare providers [8, 9]. This underscores the urgent need for detection and timely nutritional intervention as integral components of cancer management.

Although the link between GI cancers and malnutrition is known, region-specific data, particularly among treatment-naïve patients in India, are limited. Assessing the nutritional status at the time of diagnosis is a critical yet underexplored factor that may significantly influence treatment response and overall prognosis. Coimbatore, a prominent medical hub in Tamil Nadu, offers a unique setting for exploring this issue due to its growing healthcare infrastructure and high patient influx.

This research aims to address this gap by conducting a multicentric cross-sectional assessment of newly diagnosed GI cancer patients in Coimbatore. Using validated tools like Patient-Generated Subjective Global Assessment (PG-SGA) and anthropometry, the study investigates malnutrition prevalence and associated risk factors-including clinical, dietary, and socioeconomic factors. This could potentially strengthen early detection efforts and promote the integration of routine nutritional screening in oncology care.

Materials and Methods

Study design and setting

A hospital-based, cross-sectional study was conducted for five months (July-November 2023) in two multispeciality hospitals at Coimbatore, Tamil Nadu, India. These hospitals were purposively selected for their advanced gastroenterology departments and high patient turnover, making them suitable for identifying newly diagnosed GI cancers. The cross-sectional design allowed for estimation of malnutrition prevalence and identifying risk factors at a single time point.

Study population

The study included newly diagnosed, treatment-naïve GI cancer patients, aged 18 to 60 years, of either gender, admitted during the study period. Patients above 60 years were excluded to reduce confounding by age-related sarcopenia, altered metabolic demands and frailty, ensuring a more homogenous adult population. The diagnosis was confirmed through histopathological and radiological reports. Patients were eligible if they had not undergone any prior cancer treatment (e.g., chemotherapy, surgery, or radiotherapy), and were classified as Stage I, II or III based on Tumour, Nodes, Metastasis (TNM) staging. Patients in Stage IV, receiving palliative care, those with terminal illness, and those with comorbidities significantly affecting nutritional status (except common conditions like diabetes mellitus and hypertension) were excluded. Written informed consent was obtained from all eligible patients.

Sampling technique and sampling size

Purposive sampling was used to recruit patients meeting the inclusion criteria. A total of 181 patients were enrolled, although no formal sample size calculation was performed, the number was considered adequate for cross-sectional analysis and regression modeling, within the study timeframe.

Study participants

A total of 245 patients diagnosed with gastrointestinal cancer were screened for eligibility as shown in Flow chart 1. Of these, 64 were excluded: 19 had advanced-stage cancer (Stage IV), 7 were already on treatment, 16 had comorbidities significantly affecting nutritional status, 9 were aged above 60 years, and 13 declined consent. Thus, 181 patients were enrolled and completed all study assessments.

Study instrument and Data collection

Socio demographic information (age, gender, marital status, family structure and locality) were obtained as self-reports. Socio-economic status was assessed using the Modified Kuppusamy Scale (2022) [10], as it covers a diverse range of aspects including education, occupation and monthly income of the family. Based on the total score, the patients were classified into five categories such as Upper (I), Upper middle (II), Lower middle (III), Upper lower (IV) and Lower (V). Additionally, their clinical data, including site of tumour, stage of cancer and smoking history was observed from their medical records.

Nutritional screening was done using Malnutrition Universal Screening Tool (MUST) [11] and nutritional assessment was done using gold standard and validated tool called Patient-Generated Subjective Global Assessment (PG-SGA) [12]. Various categories including the patient's weight status, weight loss percentage in one and six months, symptoms that hinder their food intake, type and form of food that the patient consumes, their activity level, presence of other diseases, their metabolic demand were scored and classified as well nourished (Stage A), moderately malnourished (Stage B) and severely malnourished (Stage C).

Objective measurements were used to identify the nutritional status of the patients. Body Mass Index (BMI) was calculated using the formula Weight in kg/Height in m^2; where height and weight were collected from their medical records. Based on their BMI, the patients were classified as underweight (<18.5), normal (18.5-24.9), overweight (25.0-29.9) and obese (>30.0), according to the World Health Organisation.

Waist Hip Ratio (WHR) was calculated using the formula Waist circumference (cm)/Hip circumference (cm), with measurements obtained using a non-stretchable measuring tape. Classification was based on WHO gender-specific cut-offs (≥0.90 for males and ≥0.85 for females) to indicate normal or substantially increased risk. Mid Upper Arm Circumference (MUAC) and Calf Circumference (CC) were also measured and classified as normal or low based on WHO reference values. For comparative analysis, WHR, MUAC and CC were reported as mean values across nutritional status groups, without gender stratification.

Dietary intake was assessed using a self-reported 3-day 24-hour dietary recall. Interviews were scheduled when patients were clinically stable (i.e., not undergoing active chemotherapy or experiencing severe symptom exacerbations). Where necessary, caregivers were

consulted to cross-verify reported intake, particularly for patients experiencing symptoms such as nausea, anorexia or vomiting. Macronutrient intake, including energy, carbohydrates, protein, fat, and fibre was calculated using standard Indian Food Composition tables. Intake adequacy for energy and protein was evaluated using the ESPEN guidelines for oncology patients, with individualized requirements calculated as 25-30 kcal/kg/day for energy and 1.2-1.5 g/kg/day for protein based on each patient's body weight requirement.

All data were collected through a structured interview schedule with the patients and caregivers. The questionnaire, including socio-demographic details, MUST, PG SGA, anthropometric details, and dietary recall, was reviewed for clinical relevance by oncologists and dietitians from the respective hospitals.

Statistical Analysis

Data were analyzed using IBM SPSS version 29. Descriptive statistics summarized demographic, clinical and nutritional variables. Categorical variables were expressed as frequencies and percentages, and associations with nutritional status were tested using Chi-square test. Continuous variables were reported as Mean ± Standard Deviation (SD), and compared across nutritional categories using one-way ANOVA. Logistic regression was performed on variables significantly associated with malnutrition to identify independent predictors of malnutrition. Results were reported as Odds Ratio (OR) with 95% Confidence Intervals (CI). A $p<0.05$ was considered statistically significant. A post hoc power analysis was conducted using G*Power (version 3.1.9.7) to determine whether the sample size (n=181) was adequate to detect significant associations using logistic regression. Assuming an odds ratio of 2.0, a two-tailed α level of 0.05, and a predictor prevalence of 20%, the computed power was 92.8%, indicating sufficient statistical power.

Results

The study included 181 newly diagnosed, treatment-naïve GI cancer patients. Table 1 presents the demographic and clinical characteristics. Although the study included adults aged 18-60 years, a large population of the sample (90.06%) were between 41-60 years, reflecting the age at which most GI cancers are diagnosed in clinical settings. Male patients comprised 59.67% of the sample Most of the patients resided in urban areas (86.73%) and belonged to nuclear families(90.06%). According to Modified Kuppusamy Scale (2022), 43.09% were from the upper middle class and 34.81% from lower-middle class. Nearly two-thirds (65.74%) of the patients were non-smokers.

A higher burden of upper GI cancers (62.44%), including the cancers of the esophagus (28.33%), stomach (38.05%), pancreas (11.50%), liver (16.81%) and gall bladder (5.31%), was observed when compared to lower GI cancers (37.56%) comrpising of colon (60.29%) and rectal cancer (39.71%). With regard to the clinical staging of cancer, over half the patients were diagnosed at Stage II (55.80%), followed by Stage III (35.36%) and Stage I

Table 1. Socio-Demographic and Clinical Characteristics of the Gastrointestinal Cancer Patients (N=181)

Variables	Categories	n (%)
Age (years)	21-40	18 (9.94)
	41-60	163 (90.06)
Gender	Male	108 (59.67)
	Female	73 (40.33)
Locality	Rural	24 (13.27)
	Urban	157 (86.73)
Marital status	Married	176 (97.23)
	Unmarried	5 (2.76)
Family structure	Joint family	18 (9.94)
	Nuclear family	163 (90.06)
Socio economic status	Upper (I)	1 (0.55)
	Upper middle (II)	78 (43.09)
	Lower middle (III)	63 (34.81)
	Upper lower (IV)	37 (20.44)
	Lower (V)	0 (0.0)
Smoking status	Non-smoker	119 (65.74)
	Smoker	62 (34.26)
Site of tumour	Upper GI	113 (62.44)
	CA Esophagus	32 (28.33)
	CA Stomach	43 (38.05)
	CA Pancreas	13 (11.50)
	CA Liver	19 (16.81)
	CA Gallbladder	6 (5.31)
	Lower GI	68 (37.56)
	CA Colon	41 (60.29)
	CA Rectum	27 (39.71)
Stage of cancer	Stage I	25 (13.81)
	Stage II	101 (55.80)
	Stage III	56 (30.72)
MUST	Low risk	41 (22.65)
	Medium risk	62 (34.26)
	High risk	78 (43.09)
PG SGA	Stage A	48 (26.52)
	Stage B	78 (43.09)
	Stage C	55 (30.39)
Nutritional needs	Without need	59 (32.58)
	With need	122 (67.42)
Symptoms	Without symptoms	29 (16.02)
	Less than 3	67 (37.02)
	Greater than or equal to 3	85 (46.96)
Weight loss % in one month	Absent	101 (55.84)
	Present	80 (44.16)
Weight loss % in six months	Absent	85 (46.96)
	Present	96 (53.04)

GI, Gastrointestinal cancer; CA, Cancer; MUST, Malnutrition Universal Screening Tool; PG-SGA, Patient-Generated Subjective Global Assessment; %, percentage

Table 2. Comparison of Anthropometric Measures across Nutritional Status (N=181)

Anthropometry	Stage A (n=48)	Stage B (n=78)	Stage C (n=55)	p-value
Body Mass Index (BMI) in kg/m^2 (Mean±S.D)	24.89 ±4.45	22.28±2.01	17.18±1.29	0.506
Waist-Hip Ratio (WHR) (Mean±S.D)	0.93±0.03	0.88±0.01	0.84±0.04	0.431
Mid Upper Arm Circumference (MUAC) in cm (Mean±S.D)	24.24±3.07	23.66±2.52	22.82±2.74	0.565
Calf Circumference (CC) in cm (Mean±S.D)	28.84±2.92	28.65±2.74	27.96±2.80	0.549
Weight loss % in one month	4.28	5.14	6.45	-
Weight loss % in six months	9.31	10.5	11.38	-

One-way Anova test; %: Percentage; kg/m^2, Kilogram per metre square; cm, centimetre; S.D, Standard Deviation

(8.84%). Nutrition screening revealed that 43.09% of the patients were in high risk category. Based on PG-SGA classification, 73.5% of patients were malnourished: 43.09% were moderately malnourished (Stage B), and 30.39% were severely malnourished (Stage C). Symptom burden was high, with 46.96% reporting three or more nutrition impact symptoms (NIS), including pain (64%), nausea (45%), vomiting (32%), early satiety (39%), and dysphagia (27%). Increased nutritional needs were reported by 67.4% and over half experienced weight loss within the past six months (53.0%) and one month (44.16%).

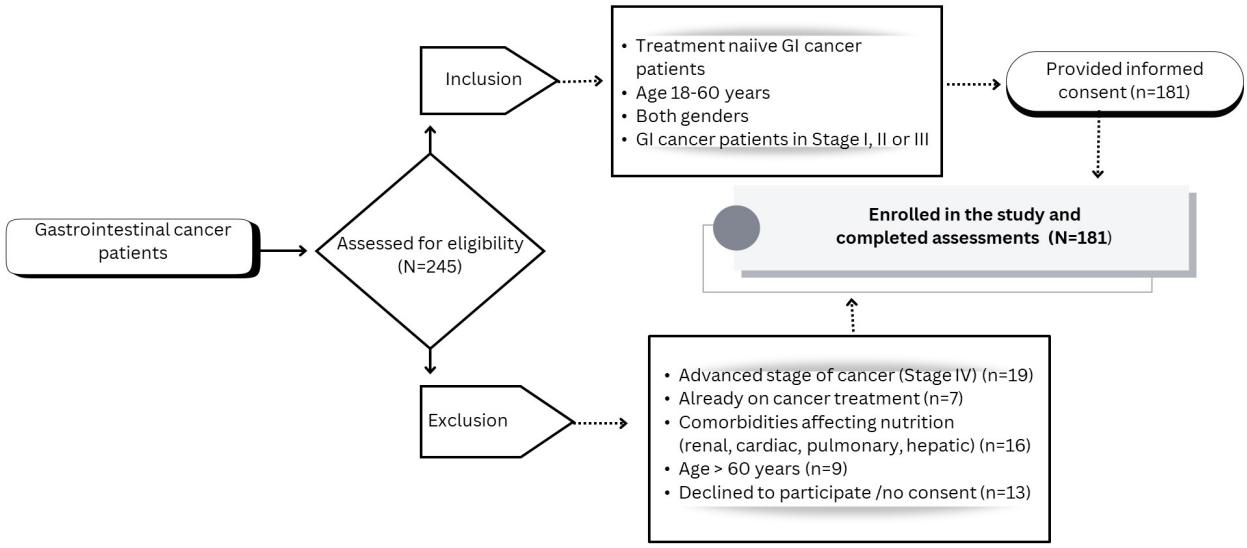
Anthropometric measures declined with worsening nutritional status and is given in Table 2. According to PG-SGA classification, the mean Body Mass Index (BMI) significantly decreased from 24.89±4.45 kg/m^2 in well-nourished patients (Stage A) to 17.18±1.29 kg/m^2 in severely malnourished patients (Stage C). Similarly, Waist Hip Ratio (WHR) showed a slight, but non-significant reduction from 0.90±0.05 in Stage A to 0.88±0.04 in Stage C. MUAC decreased from 27.36±2.53 cm in Stage A to 24.71±2.31 cm in Stage C, while CC also declined from 32.70±2.29 cm to 30.57±2.84 cm. Weight loss percentage in the past one month increased from 4.28% in Stage A to 6.45% in Stage C. Notably, prior to hospitalization, weight loss over the past six months increased from 9.31% to 11.38% respectively. These findings reflect consistent and progressive decline in body composition including the muscle mass and fat mass with worsening nutritional status, although statistical significance was not reached.

The dietary intake differences across nutritional status were recorded and is given in Table 3. Mean energy intake significantly declined from 1758.04±135.36 Kcal/day in Stage A to 1687.69±107.47 kcal/day in Stage B and further

Table 3. Comparison of Dietary Intake across Nutritional Status (N=181)

Dietary recall	Stage A (n=48)	Stage B (n=78)	Stage C (n=55)	p-value
Energy (Kcal)	1758.04±135.36	1687.69±107.47	1383.84±169.89	<0.001**
Carbohydrate (g)	241.73±18.61	232.06±14.78	190.28±23.36	<0.001**
Protein (g)	49.75±6.51	45.75±5.89	35.48±5.96	<0.001**
Fat (g)	39.07±3.01	37.50±2.39	30.75±3.78	<0.001**
Fibre (g)	26.96±7.46	28.92±5.48	25.95±4.43	0.107

One-way ANOVA test; Kcal, Kilocalorie; g, gram; **p<0.001



Flow Chart 1. Selection of Study Participants

Table 4. Chi Square Analysis of Malnutrition Status with Demographic and Clinical Variables (N=181)

Variables	Categories	Stage A (n=48)	Stage B (n=78)	Stage C (n=55)	Total	P value
Age (years)	21-40	5 (10.42)	12 (15.38)	1 (1.82)	18 (9.94)	0.036*
	41-60	43 (89.58)	66 (84.6)	54 (98.2)	163 (90.1)	
Gender	Male	33 (68.8)	45 (57.7)	30 (54.5)	108 (59.7)	0.306
	Female	15 (31.3)	33 (42.3)	25 (45.5)	73 (40.3)	
Locality	Rural	8 (16.7)	13 (16.7)	3 (5.5)	24 (13.3)	0.123
	Urban	40 (83.3)	65 (83.3)	52 (94.5)	157 (86.7)	
Marital status	Unmarried	0 (0.0)	4 (5.1)	1 (1.8)	5 (2.8)	0.205
	Married	48 (100.0)	74 (94.9)	54 (98.2)	176 (97.2)	
Family structure	Joint family	3 (6.3)	5 (6.4)	10 (18.2)	18 (9.9)	0.052
	Nuclear family	45 (93.8)	73 (93.6)	45 (81.8)	163 (90.1)	
Socio economic status	Upper (I)	1 (2.1)	2 (2.6)	0 (0.0)	3 (1.7)	0.749
	Upper middle (II)	23 (47.9)	32 (41.0)	23 (41.8)	78 (43.1)	
	Lower middle (III)	17 (35.4)	25 (32.1)	21 (38.2)	63 (34.8)	
	Upper lower (IV)	7 (14.6)	19 (24.4)	11 (20.0)	37 (20.4)	
	Lower (V)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	
Site of tumour	Upper GI	20 (41.7)	43 (55.1)	50 (90.9)	113 (62.4)	<0.001**
	Lower GI	28 (58.3)	35 (44.9)	5 (9.1)	68 (37.6)	
Stage of cancer	Stage I	25 (52.1)	0 (0.0)	0 (0.0)	25 (13.8)	<0.001**
	Stage II	23 (47.9)	78 (100.0)	0 (0.0)	101 (55.8)	
	Stage III	0 (0.0)	0 (0.0)	55 (100.0)	55 (30.4)	
Smoking status	Non-smoker	30 (62.5)	54 (69.2)	35 (63.6)	119 (65.7)	0.686
	Smoker	18 (37.5)	24 (30.8)	20 (36.4)	62 (34.3)	
Nutritional needs	Without need	48 (100.0)	11 (14.1)	0 (0.0)	59 (32.6)	<0.001**
	With need	0 (0.0)	67 (85.9)	55 (100.0)	122 (67.4)	
Symptoms	Without symptoms	29 (60.4)	0 (0.0)	0 (0.0)	29 (16.0)	<0.001**
	Less than 3	16 (33.3)	51 (65.4)	0 (0.0)	67 (37.0)	
	Greater than or equal to 3	3 (6.3)	27 (34.6)	55 (100.0)	85 (47.0)	
Weight loss percentage in one month	Absent	32 (66.7)	44 (56.4)	25 (45.5)	101 (55.8)	0.096
	Present	16 (33.3)	34 (43.6)	30 (54.5)	80 (44.2)	
Weight loss percentage in six months	Absent	32 (66.7)	33 (42.3)	20 (36.4)	85 (47.0)	0.005*
	Present	16 (33.3)	45 (57.7)	35 (63.6)	96 (53.0)	
BMI	Underweight	5 (10.4)	12 (15.4)	17 (30.9)	34 (18.8)	0.004**
	Normal	13 (27.1)	32 (41.0)	23 (41.8)	68 (37.6)	
	Overweight	23 (27.1)	28 (35.9)	15 (27.3)	66 (37.6)	
	Obese	7 (14.6)	6 (84.6)	0 (0.0)	13 (7.2)	
WHR	Normal	4 (8.3)	12 (15.4)	9 (16.4)	25 (13.8)	0.433
	Substantially increased	44 (91.7)	66 (84.6)	46 (83.6)	156 (86.2)	
MUAC	Underweight	22 (45.8)	43 (55.1)	32 (58.2)	97 (53.6)	0.319
	Normal	23 (47.9)	33 (4.3)	23 (41.8)	79 (43.6)	
	Overweight	3 (6.3)	2 (2.6)	0 (0.0)	5 (2.8)	
	Obese	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	
CC	Normal	1 (2.1)	3 (3.8)	1 (1.8)	5 (2.8)	0.739
	Low	47 (97.9)	75 (96.2)	54 (98.2)	176 (97.2)	
Energy Intake	Normal	20 (41.7)	4 (5.1)	0 (0.0)	24 (13.3)	<0.001**
	Low	28 (58.3)	74 (94.9)	55 (100.0)	157 (86.7)	
Protein Intake	Normal	13 (27.1)	1 (1.3)	0 (0.0)	14 (7.7)	<0.001**
	Low	35 (72.9)	77 (98.7)	55 (100.0)	167 (92.3)	

GI, Gastrointestinal; BMI, Body Mass Index; WHR, Waist Hip Ratio; MUAC, Mid Upper Arm Circumference; CC, Calf Circumference; **p<0.001, *p<0.005

Table 5. Logistic Regression Analysis of Factors Associated with Malnutrition (N=181)

Variables	B	Sig.	Exp (B)	95% C.I for Exp (B)	
				Lower	Upper
Age	0.071	0.899	1.073	0.361	3.188
Type of cancer	-1.18	0.001**	0.307	0.155	0.608
Body Mass Index	-0.676	0.002*	0.509	0.335	0.773
Weight loss % in six months	1.105	0.002**	3.019	1.509	6.039
Energy intake	3.137	<0.001**	23.036	7.304	72.654
Protein intake	3.892	<0.001**	49.029	6.2	87.69
Symptoms	-1.817	<0.001**	0.162	0.09	0.244
Nutritional needs	-1.201	<0.001**	0.301	0.238	0.38
Stage of cancer	-0.598	<0.001**	0.55	0.478	0.634

%, Percentage; B, Beta value; Sig, Significant value; Exp (B), Exponential Beta; C.I, Confidence Interval; **p<0.001; *p<0.005

to 1383.84±169.89 kcal/day in Stage C. Carbohydrate intake followed a similar trend, decreasing from 241.73±18.61 g/day in Stage A to 232.06±14.78 g/day in Stage B and 190.28±23.36 g/day in Stage C. Similarly, protein intake dropped in malnourished individuals, with mean values declining from 49.75±6.51 g/day in Stage A to 45.75±5.89 g/day in Stage B and 35.48±5.96 g/day in Stage C. Fat intake also showed a stepwise reduction, decreasing from 39.07±3.01 g/day in Stage A to 30.75±3.78 g/day in Stage C. All the macronutrients showed statistically significant differences across the nutritional status (p<0.0001). However, the fibre intake did not differ significantly across groups (p=0.107). These underscore the progressive reduction in dietary intake associated with malnutrition and emphasize the importance of nutritional monitoring and support.

Chi square analysis (Table 4) revealed significant associations between nutritional status and age group (p=0.036), site of tumour (p<0.001), stage of cancer (p<0.001), increased nutritional needs (p<0.001), symptom burden (p<0.001). Among anthropometric variables, BMI was significantly associated with nutritional status (p=0.004), with underweight patients forming the majority of the severely malnourished group. Six-month weight loss percentage also showed a significant association (p=0.005). In terms of dietary intake, both energy and protein intake were significantly associated with malnutrition (p<0.001), with a higher proportion of malnourished patients failing to meet their daily macronutrient requirements.

Logistic regression analysis identified several key independent predictors of malnutrition among GI cancer patients as shown in Table 5. The type of cancer emerged as a significant factor, with patients having upper GI malignancies more likely to be malnourished (OR=0.307, 95% CI: 0.155-0.608, p=0.001). Similarly, low BMI was associated with a significantly higher risk of malnutrition (OR: 0.509, 95% CI: 0.335-0.773, p=0.002). Weight loss % over a six-month period was also an important predictor (OR; 3.019, 95% CI: 1.509-6.039, p=0.002), suggesting that each % increase in weight loss considerably raised the odds of being malnourished.

In terms of dietary intake, inadequate energy intake (OR=23.036, 95% CI: 7.304-72.654, p<0.001) and inadequate protein intake (OR=49.029, 95% CI: 6.200-87.69, p<0.001) were found to be the strongest nutritional predictors. Additionally, the presence of nutrition impact symptoms significantly increased the likelihood of malnutrition (OR: 0.162, 95% CI: 0.090-0.244, p<0.001). Patients reporting increased nutritional needs also had higher odds of being malnourished (OR: 0.301, 95% CI: 0.238-0.380, p<0.001). Furthermore, advanced stage of cancer independently predicted higher malnutrition risk (OR=0.550, 95% CI: 0.478-0.634, p<0.001). These findings collectively emphasize the interplay between clinical, dietary and metabolic factors in determining nutritional status in GI cancer patients.

Discussion

Malnutrition in cancer patients is multifactorial, driven by tumour-related, treatment-related, metabolic, and socio-economic factors [13]. This multicentric cross-sectional study revealed that 73.5% of newly diagnosed GI cancer patients were moderately or severely malnourished, as per the PG SGA tool, aligning with Silva et al., 2015, who reported a 71.1% prevalence [14]. Upper GI cancers accounted for 62.4% of cases and were significantly associated with malnutrition (p<0.001). This supports a recent meta-analysis, showing higher malnutrition prevalence in upper GI cancers, particularly esophageal (78%) and gastric cancers (75%), than in the lower GI cancers. Upper GI tumours impair swallowing, digestion, and absorption, leading to rapid nutritional decline [15]

Age was also significantly associated with malnutrition (p=0.036), with the 41-60 age group most affected. Though not geriatric, the middle-aged patient group may face early functional decline and symptom burden, highlighting that nutritional vulnerability spans across all adult age groups. Family structure also showed a borderline significant association with nutritional status (p=0.052), with a higher proportion of severely malnourished patients coming from joint families, possibly refelcting resource dilution in larger households or a delay in care-seeking.

Malnutrition worsened with cancer stage; all Stage III patients were severely malnourished (p<0.001), echoing Cao et al., 2021, who linked advanced stage to increased

metabolic demands and cachexia [16]. Symptom burden was another major contributor, with 47% of patients reporting ≥3 NIS, a pattern significantly associated with malnutrition ($p<0.001$). Zhang et al., 2014, similarly documented high prevalence of NIS in 80.7% of GI cancer patients, including nausea or fullness (27.7%), choking (14.3%), appetite loss, vomiting, and diarrhoea in 38.8% of the patients [17]. These symptoms compromise oral intake and elevate catabolic stress, supporting ESPEN's recommendation for early symptom management [7].

Progressive decline was observed in anthropometric measures as nutritional status worsened. BMI showed a significant decrease ($p=0.004$), with underweight individuals representing a major proportion of the severely malnourished group. Though MUAC and CC were not statistically significant, mean values decreased across PG SGA categories, reflecting fat and muscle loss. Jamshidi et al., 2018, similarly noted reduced BMI, MUAC and CC in GI cancer patients, reinforcing their utility as a practical, bedside tools in resource limited settings [18]. Weight loss over six-months was significantly associated with malnutrition ($p=0.005$); 53% reported >5% weight loss. This mirrors the NOURISH study, which found 49% of upper GI cancer patients had lost 5% weight, making it a strong predictor of malnutrition [9]. These results reinforces the use of recent weight loss history as a simple yet powerful marker for early malnutrition detection.

Dietary intake analysis showed significant stepwise reductions in energy, carbohydrate, protein, fat and fibre across nutritional categories ($p<0.001$). Severely malnourished patients consumed an average of 35.48±5.96 g/day of protein, which is markedly below the ESPEN-recommended 1.2-1.5g/kg/day for cancer patients. Similarly, Molfino et al. [19] reported that 48% of newly diagnosed cancer patients, particularly those with gastroesophageal cancers, were hypophagic, consuming only 18.4 kcal/kg/day and 0.8 g/kg/day protein-both below ESPEN guidelines. These findings emphasize that nutritional deficits often begin early in the disease trajectory and worsen with disease progression, especially in upper GI cancers. Alarmingly, all severely malnourished patients in our study had energy and protein intakes below recommended levels.

Although fibre intake was not statistically different across nutritional status, this likely reflects uniformly low intake among all patients. This may be attributed to common symptom-driven dietary modifications, such as avoidance of high residue foods due to nausea, early satiety or gastrointestinal discomfort. Additionally, baseline regional dietary patterns low in fruits, vegetables and whole grains may have contributed. While fibre is not a direct determinant of energy balance, it plays a critical role in digestive health, symptom management, and overall dietary quality, and should not be overlooked in nutritional interventions.

Chi-square analysis revealed several independent variables significantly associated with malnutrition, namely: age, tumour site, stage of cancer, NIS, nutritional needs, BMI, weight loss, and macronutrient intake. These findings are in line with Mohsin et al., 2024, who reported associations with age, gender, tumour site, treatment, and performance status [20].

Logistic regression identified BMI and weight loss percentage as key independent predictors. Each unit increase in BMI reduced malnutrition odds by 49.1%, while each percent of weight loss increased malnutrition risk by 20.19 times. These findings emphasize the clinical relevance of both chronic nutritional status (as evidenced by BMI) and recent nutritional decline (as reflected by weight loss), which are core components of malnutrition diagnostic criteria.

Inadequate energy and protein intake, presence of NIS, advanced cancer stage and increased nutritional needs further elevated malnutrition risk. The high frequency of NIS, such as pain, nausea, vomiting, early satiety and dysphagia, may partly explain the reduced intake observed across all macronutrients, particularly in severely malnourished patients. This symptom profile suggests that screening protocols should focus on identifying NIS early. Tools such as the PG-SGA or symptom-specific checklists can help clinicians quickly identify patients at risk due to NIS. Yi and Hong (2024), similarly identified NIS and weight loss percentage to be the key factors associated with malnutrition, thus stressing the importance of early screening and tailored nutritional support, particularly in patients with high metabolic demands [21].

This study has several notable strengths. Its multicentric design, involving two tertiary care hospitals, enhances the diversity and relevance of the findings to urban clinical settings. The use of a validated assessment tool (PG-SGA) ensured robust evaluation of nutritional status, while the inclusion of a wide range of variables allowed for a comprehensive analysis of malnutrition risk factors. Additionally, focusing on treatment-naïve GI cancer patients provided a clear baseline view of nutritional status unaffected by treatment. Statistical analysis was thorough, employing chi-square tests, ANOVA and logistic regression to identify independent predictors of malnutrition.

However, the cross-sectional design limits causal interpretation. The purposive sampling approach and restriction to two hospitals may limit generalizability, particularly to rural and lower resource settings. Body composition parameters were not assessed, limiting insights into muscle and fat loss. Although anthropometric measures such as WHR, MUAC, and CC were obtained, they were reported as pooled means without gender stratification, potentially obscuring gender-specific trends. Nutritional status and dietary intake were evaluated using subjective and self-reported tools, which may introduce recall or reporting bias. Nonetheless, these findings provide valuable insights into early nutritional risk among treatment-naiive GI cancer patients and emphasize the need for timely screening, assessment, and intervention.

In conclusion, malnutrition is highly prevalent among newly diagnosed cancer patients, even before the initiation of treatment. The present study highlights that nutritional risk is significantly influenced by both modifiable (BMI, dietary intake, symptom burden) and non-modifiable (weight loss history and stage of cancer) factors. The PG SGA, combined with anthropometric and dietary assessments, serves as an effective screening

tool. Early intervention targeting energy and protein intake, symptom management, and individualised care plans should be integrated into routine oncology practice to improve patient outcomes and treatment tolerance. These findings support the implementation of nutritional screening, assessment and intervention at the time of cancer diagnosis, particularly for high-risk GI cancer patients.

Author Contribution Statement

SJ: data collection and compilation, conceptualization, manuscript drafting, statistical analysis, reviewing & editing. TS: supervision of data collection, provided guidance on clinical implications of research findings, critical review of manuscript and guidance on manuscript refinement.

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Scientific Body Approval/Thesis Statement

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Ethical disclosure

Ethical clearance was obtained from the Institutional Human Ethics Committee (IHEC) of Avinashilingam Institute for Home Science and Higher Education for Women (Approval No: AUW/IHEC/FSMD-22-23/FHP-6), dated 10.02.2023. The details of the study and its objectives were explained to the patients and written informed consent was obtained.

Availability of data

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

Study Registration

This study was not registered in any clinical trial or systematic review registry as it did not meet the criteria for mandatory registration. However, appropriate institutional permissions were obtained from the selected multispecialty hospitals following the approval granted by the Institutional Human Ethics Committee (IHEC).

Conflict of Interest

The authors declare that there is no conflict of interest

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