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Malnutrition in hospitalized cancer patients: A single-center, cross-sectional study in Southern Vietnam

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Nguyen Van Tap[1], Ho Tat Bang[2,3], Duong Thi Huong[4], Pham Cong Chi[5] and Le Thi Ngoc Anh[6]

Abstract

Objectives: Malnutrition in cancer patients reduces response to chemotherapy, increases the hospitalization costs, hospital infections, and deaths. The aim of this study was to determine the prevalence, level of malnutrition, and its related factors in cancer patients at a local hospital in Southern Vietnam.

Methods: A descriptive cross-sectional study was performed on all 118 cancer patients who were undergoing inpatient treatment at Long An General Hospital, Vietnam from May to September 2020. Data were collected from patients by face-to-face interviewing using a subjective global assessment (SGA) and from medical records. Malnutrition is divided into three groups: SGA-A (normal), SGA-B (mild/moderate/suspected malnutrition), SGA-C (severe malnutrition). Multivariable logistic regression is used to identify factors related to malnutrition with statistical significance $p < 0.05$.

Results: Out of 118 participants, 72 (61.0%) were males and 84 (71.2%) aged ⩾60 years. The prevalence of malnutrition in cancer patients was 84.7% (100/118), in which 33% (39/118) were severe (SGA-C) and 51.7% (61/118) were mild–moderate (SGA-B). Pancreatic and lung cancers are the most malnourished. The results of multivariate logistic regression analysis showed that the factors related to malnutrition in cancer patients were gastrointestinal symptoms lasting 2 weeks (odds ratio: 6.10, 95% confidence interval: 1.12–33.35), patients with decreased motor function (odds ratio: 13.73, 95% confidence interval: 2.56–73.86), blood albumin <35 g/l (odds ratio: 6.42, 95% confidence interval: 1.54–26.82), and blood lymphocyte ⩽ 1700 cells/mm^3 (odds ratio: 5.36, 95% confidence interval: 1.31–21.97).

Conclusions: There was a high proportion of malnutrition in cancer patients. Therefore, it is necessary to strengthen nutrition counseling and intervention for these patients, especially those that have prolonged gastrointestinal symptoms, reduced motor function, and low blood albumin or low blood lymphocytes.

Keywords

Cancer, hospitalized malnutrition, nutrition assessment, patient, subjective global assessment

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[1]Faculty of Medical Management, Nguyen Tat Thanh University, Ho Chi Minh City, Vietnam
[2]University Medical Center HCMC, University of Medicine and Pharmacy at Ho Chi Minh City, Ho Chi Minh City, Vietnam
[3]Faculty of Public Health, University of Medicine and Pharmacy at Ho Chi Minh City, Ho Chi Minh City, Vietnam
[4]Long An General Hospital, Tan An, Long An, Vietnam
[5]Tan Hung District Medical Center, Tan Hung, Tan An, Long An, Vietnam
[6]Institute of Public Health, Ho Chi Minh City, Vietnam

Corresponding authors:
Le Thi Ngoc Anh, Department of Health Planning, Institute of Public Health, 159 Hung Phu street, Ward 8, District 8, Ho Chi Minh City 73008, Vietnam.
Email: lengocanh309@yahoo.com

Ho Tat Bang, University Medical Center HCMC, University of Medicine and Pharmacy at Ho Chi Minh City, 215-217 Hong Bang Street, District 5, Ho Chi Minh City 72714, Vietnam.
Email: hotatbang@ump.edu.vn

Introduction

Malnutrition is a deficiency, excess or imbalance of energy, protein, and other nutrients that causes loss of shape, reduction or loss of function of tissues, especially muscle tissue, as well as clinical and laboratory signs.[1,2] Malnutrition in cancer patients increases hospital stays, hospital-acquired infections, and mortality.[3,4,5] In addition, malnutrition also reduces the quality of life, resists the treatment drugs, reduces the body's resistance, and has a worse overall prognosis.[6]

Studies show that malnutrition is common in hospitals, with 20–50% of patients being malnourished on admission.[7,8] According to a study in Singapore (2012), about one-third of hospitalized patients are malnourished. The highest rates of malnutrition were among patients with cancer (71%), endocrine diseases (48%), and respiratory diseases (47%). This study demonstrates the need for strategies to prevent and treat malnutrition in the hospital and after discharge for these patients.[5] According to Bozzetti et al.[9] 40% of cancer outpatients have lost more than 10% of their body weight and more than 50% have anorexia. Cancer patients are the most malnourished among other patients at the hospital.

There are many methods to assess the nutritional status of patients, in which the subjective global assessment (SGA) is a screening tool for nutritional status with high sensitivity and specificity.[10,11] Currently, SGA has been developed and widely used in many countries around the world.

At Long An General Hospital, the nutritional care needs of patients are increasingly concerned, especially in cancer patients. Therefore, this study was conducted to provide scientific information, which is the basis for developing a plan to improve the nutritional status of cancer patients, contributing to improving treatment efficiency, reducing hospital stay and treatment costs for the patient. The objective of the study was to determine the prevalence, level of malnutrition, and its related factors in cancer patients at a local hospital in Southern Vietnam.

Materials and methods

Study settings and design

A descriptive cross-sectional study was conducted on all cancer patients undergoing inpatient treatment at Long An Provincial General Hospital, Southern Vietnam from May to September 2020.

Participants, sample size, and sampling

The inclusion criteria of the study were cancer patients with confirmed diagnosis through pathological results. Participants have the ability to contact and answer interview questions. Exclusion criteria were patient with mental illness, cognitive disorder, or patient with aphasia has trouble expressing or understanding language. The study also excluded those who did not consent to participate in the study and people who died during the treatment.

The study used the formula to calculate the sample size to estimate 1 ratio with $p=0.8$ being the rate of malnutrition of cancer patients according to the study of Sánchez-Lara K et al.[12] and $d=0.8$, $Z_{(1-\alpha/2)}=1.96$. We calculated the sample size $n=94$.

During the data collection period, we recruited all 118 cancer patients undergoing inpatient treatment at Long An Provincial General Hospital from May to September 2020. The study sample conveniently selected all cancer patients who met the sampling criteria during the study period.

Data collection and tools

Study participants were interviewed face to face using a SGA questionnaire. This tool had a sensitivity of 84.3% and a specificity of 91.4%.[10] Nutritional status assessed according to SGA includes three levels[11]:

(i) SGA-A (normal): Maintain weight or gain weight, or lose weight <5% within 6 months, without edema. In the case of 5–10% weight loss in 6 months, or mild subcutaneous fat loss. However, the patient showed signs of weight gain or weight maintenance during the last 2 weeks, or recent improvement in diet (increased eating, switching from liquid to solid food).
(ii) SGA-B (mild/moderate malnutrition or suspected malnutrition): weight loss of at least 5% within 2 weeks or reduced dietary intake, signs of less subcutaneous fat loss or mild muscle atrophy.
(iii) SGA-C (severe malnutrition): weight loss is more than 10% within 6 months, and there is poor appetite (eating viscous or liquid food) lasting 2 weeks, or there are obvious signs of loss of subcutaneous fat layer, muscle atrophy severe or accompanied by edema, and edema of the lumbar spine.

The variables in the study included demographic characteristics such as age (<60, ⩾60), sex (male, female), accommodation (rural, urban), education level (⩽ primary school, junior high school, ⩾ high school), economic status (⩽poor and near poor) (having a certificate of poor or near-poor household issued by the Commune or Ward People's Committee), ⩾afford and well-off), and body mass index (BMI; ⩽18.5 kg/m^2, >18.5 kg/m^2).[13] Variables for the type of cancer (lung, colon, stomach and esophagus, liver, pancreas and gall bladder, mouth, pharynx, tonsils, nasopharynx, cervix, ovaries, and others). We also collected variables for comorbidities such as hypertension (yes/no), diabetes (yes/no), cardiovascular disease (yes/no), chronic kidney (yes/no), and chronic obstructive pulmonary disease (yes/no). In addition, there were gastrointestinal symptoms lasting 2 weeks including nausea (yes/no), anorexia (yes/no), vomiting (yes/

Table 1. Participants' demographic characteristics ($n = 118$).

Characteristics	Frequency (n)	Percentage (%)
Age (years)	Mean ± SD: 65.6 ± 12.3	Min–Max: 20–89
<60	34	28.8
⩾60	84	71.2
Sex		
Male	72	61.0
Female	46	39.0
Accommodation		
Rural	75	63.5
Urban	43	36.4
Education level		
⩽Primary school	76	64.4
Junior high school	25	21.4
⩾High school	17	14.5
Economic status		
⩽Poor and near poor	24	20.3
⩾Afford and well-off	94	79.7
BMI (kg/m^2)		
>18.5 kg/m^2	53	44.9
⩽18.5 kg/m^2	65	55.1

BMI: body mass index; SD: standard deviation.

no), diarrhea (yes/no), reduced motor function (yes/no), reduced motor function type (no reduction, reduced function when working, lying completely in bed), stress (yes/no), and stress levels (no, mild and moderate, severe). In addition, weight change variables for the last 6 months and 2 weeks were also collected (unchanged, lower than 5%, lower from 5% to 10%, lower >10%, and increased less than 5%), variable about food intake changes (yes/no), change to diet (special porridge diet, diet with enough energy, low energy fluid diet, hungry diet). Laboratory variables evaluated included albumin (<35 g/l, ⩾35 g/l), lymphocytes (⩽1700 cells/mm^3, >1700 cells/mm^3),[14] and clinical symptoms variables including loss of subcutaneous fat of triceps or pectorals (yes, no), muscle atrophy of quadriceps or deltoids or temples (yes, no), swollen feet (yes, no), and ascites (yes, no).

We collected the variables by interviewing patients face to face, measuring the patient's weight and height, and gathering information from the patient's medical records and laboratory results.

Statistical analysis

The research data were entered using EpiData Entry software (version 3.1, EpiData Association) and analyzed using Stata software (version 16.0, Stata Statistical Software: Release 16, StataCorp LLC, College Station, TX, USA) To analyze the factors related to malnutrition, we first used chi-square test and Fisher's exact test for univariate analysis. Then, we selected all the variables with $p < 0.2$ into the multivariable logistic regression model and used stepwise forward analysis to gradually remove the unrelated variables from the model. The remaining variables in the final model were the variables with $p < 0.05$ and the variables with $p > 0.05$, if this variable were removed from the model, it had changed >20% of the other variables in the model. We compared the new model with the old model using the likelihood ratio test. The significance level used in the study was $\alpha < 0.05$ with odds ratio (OR) and 95% confidence interval (CI).

Results

At the time of the study, there were a total of 121 cancer patients being treated at the Long An Provincial General Hospital. However, there were three elderly patients who were not able to answer the interview, so they were excluded from the study. As a result, we collected 118 cancer patients who met the sampling criteria for inclusion in the study. No patients refused to participate in the study.

Characteristics of study participants

Table 1 shows that the patients in our study had a mean age of 65.6 ± 12.3, in which the youngest patient was 20 years old and the oldest patient was 89 years old. The percentage of patients over 60 years of age was 71.2% and 61.0% were male. There were 63.5% of patients living in rural areas, 64.4% with ⩽ primary school education level, and 20.3% with poor and near-poor economic status. The percentage of cancer patients with BMI ⩽ 18.5 kg/m^2 was 55.1% and BMI > 18.5 kg/m^2 was 44.9%.

Type of cancers

Study participants mainly had cancers such as lung 20.4% (24/118), colon 17.8% (21/118), and stomach and esophagus 17.8% (21/118). There are 10.2% (12/118) of people with other types of cancer including soft tissue, lymph nodes, prostate, breast, parotid gland, and lacrimal sinus (Figure 1).

The comorbidities

Table 2 shows that out of 108 cancer patients participating with comorbidities, 38 had high blood pressure (32.2%), 14 had diabetes (11.8%), 12 had cardiovascular disease (10.2%), 8 with chronic kidney failure (6.8%), 6 people with hepatitis B or C or cirrhosis (5.1%), 5 people with pneumonia (4.2%), 3 people with COPD, and 22 people with other comorbidities such as clotting disorders, anemia, hyperkalemia, albinism, cerebrovascular accident, and gastrointestinal infections.

Symptoms of gastrointestinal disease, reduced motor function, and patient's stress status

There were 39% (46/118) of patients with gastrointestinal symptoms. In which, the most symptoms were nausea, anorexia, and vomiting accounted for 23.7% (28/118), 19.5%

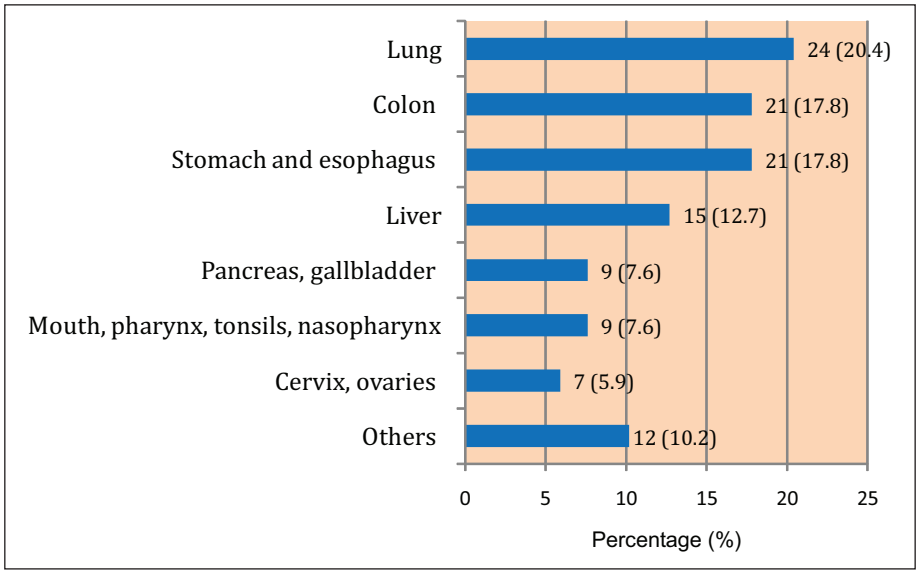

Figure 1. Types of cancer patients in the study ($n = 118$).

Table 2. Comorbidities ($n = 108$).

Comorbidities	*N* (%)
Hypertension	38 (32.2)
Diabetes	14 (11.8)
Cardiovascular disease	12 (10.2)
Chronic kidney failure	8 (6.8)
Hepatitis B/C or cirrhosis	6 (5.1)
Pneumonia	5 (4.2)
Chronic obstructive pulmonary disease	3 (2.5)
Others	22 (18.6)

(23/118), and 15.3% (18/118), respectively. There were 55.1% (65/118) of patients with reduced motor function. In which, the percentage of people who have to lie completely on the bed were 33.1% (39/118). The proportion of patients under stress accounted for 81.4% (96/118), of which 39.9% (47/118) were severely stressed (Table 3).

Weight change in the last 6 months and 2 weeks

The results of Table 4 show that the percentage of patients who lost weight from 5% to 10% in 6 months was 39.8% and in 2 weeks 19.5% and lost >10% in 6 months was 17.8%, in the last 2 weeks was 68.6%.

Change to diet, paraclinical indicators, and clinical symptoms

Table 5 shows that most of the patients changed their diet which accounted for 91.5%, of which the low energy fluid diet accounted for 42.4%, diet with enough energy was 22.0%, special porridge diet was 19.5%, and hungry diet was 7.6%. Regarding some subclinical indicators, 70.3% of patients had albumin <35 g/l and 60.2% of patients had lymphocytes ⩽1700 cells/mm^3. Regarding clinical symptoms, 41.5% of patients had muscle atrophy (quadriceps or deltoids or temples), 18.6% of patients had the presence of edema as swollen feet, 8.5% had loss of subcutaneous fat (triceps, pectorals), and 1.7% suffer from ascites.

Assessment of malnutrition according to the SGA

The rate of malnutrition of cancer patients according to SGA was 84.7% (100/118) with 95% CI: 78.2–91.3%, of which 33.0% (39/118) were severely malnourished and 51.7% (61/118) were mildly and moderately malnourished (Figure 2).

Figure 3 shows that the majority of cancer patients are undernourished, accounting for 61.9–100%, of which pancreatic and gallbladder cancers have the highest rate of malnutrition (100%) followed by lung cancer (95.8%) and liver cancer (86.7%).

Factors associated with malnutrition in cancer patients

The results of multivariate regression analysis (Table 6) showed that the factors related to malnutrition include gastrointestinal symptoms lasting 2 weeks, reduced motor function, albumin, and blood lymphocytes. Among them, those with gastrointestinal symptoms lasting 2 weeks had a 6.10 times higher risk of malnutrition than those without these symptoms (OR: 6.10, 95% CI: 1.12–33.35). Patients with reduced motor function were 13.73 times more likely to be malnourished than those without reduced motor function (OR: 13.73, 95% CI: 2.56–73.86). Patients with serum albumin <35 g/l had

Table 3. Gastrointestinal symptoms, reduced motor function and stress ($n = 118$).

Gastrointestinal symptoms. reduced motor function and stress	*n* (%)
Gastrointestinal symptoms lasting 2 weeks	
No	72 (69.0)
Yes	46 (39.0)
The main symptoms of gastroenteritis	
Nausea	28 (23.7)
Anorexia	23 (19.5)
Vomit	18 (15.3)
Diarrhea	2 (1.7)
Reduced motor function	
No	53 (44.9)
Yes	65 (55.1)
Reduced motor function type	
No reduction	53 (44.9)
Reduced function when working	26 (22.0)
Lying completely on bed	39 (33.1)
Stress	
No	22 (18.6)
Yes	96 (81.4)
Stress levels	
No	22 (18.6)
Mild and moderate	49 (41.5)
Severe	47 (39.9)

Table 4. Weight change in the last 6 months and 2 weeks ($n = 118$).

Weight change	The last 6 months *n* (%)	The last 2 weeks *n* (%)
Unchanged	3 (2.5)	3 (2.5)
Lower than 5%	43 (36.4)	9 (7.6)
Lower from 5% to 10%	47 (39.8)	23 (19.5)
Lower > 10%	21 (17.8)	81 (68.6)
Increased less than 5%	4 (3.4)	2 (1.7)

6.42 times higher the risk of malnutrition compared with those with albumin ⩾35 g/l (OR: 6.42, 95% CI: 1.54–26.82). Patients with lymphocytes ⩽1700 cells/mm^3 had a 5.36 times higher risk of malnutrition than those with lymphocytes >1700 cells/mm^3 (OR: 5.36, 95% CI: 1.31–21.97). However, there was no association between malnutrition and age, sex, accommodation, education level, economic status, hypertension, diabetes, stress, and BMI ($p > 0.05$).

Discussion

The patients in our study had a mean age of 65.6 ± 12.3, in which the youngest patient was 20 years old and the oldest patient was 89 years old. The majority of the study participants were 60 years old or older, accounting for 71.2%. Similarly, Ngo Thi Linh performed at Viet Duc Friendship Hospital, Vietnam also showed that the mean age of cancer patients in this study was 60.3 ± 14.0 years old.[15] This result is consistent with the fact that Vietnam is facing an aging population, the mean age of Vietnamese people has now increased (73.6 years old). The older a person is, the longer the duration of exposure to risk factors, and the higher the incidence of cancer.[16,17] In our study, the proportion of men was higher than women (61.0%), similar to the study of Quynh et al. (2018) with 61.3% of men.[18] In addition, the results of our study also show that 63.5% of the patients live in rural areas, 64.4% have an education level of primary

Table 5. Dietary changes, para clinical indicators, and clinical symptoms ($n = 118$).

Dietary changes, para clinical indicators, and clinical symptoms	*n* (%)
Food intake changes	
No	21 (17.8)
Yes	97 (82.2)
Change to diet	
Special porridge diet	23 (19.5)
Diet with enough energy	26 (22.0)
Low energy fluid diet	50 (42.4)
Hungry diet	9 (7.6)
No change to diet	10 (8.5)
Some paraclinical indicators	
Albumin	
⩾35 g/l	35 (29.7)
<35 g/l	83 (70.3)
Lymphocyte	
>1700 lymphocyte/mm^3	47 (39.8)
⩽1700 lymphocyte/mm^3	71 (60.2)
Clinical symptoms	
Loss of subcutaneous fat (triceps, pectorals)	10 (8.5)
Muscle atrophy (quadriceps, deltoids, temples)	49 (41.5)
Presence of edema (swollen feet)	22 (18.6)
Ascites	2 (1.7)

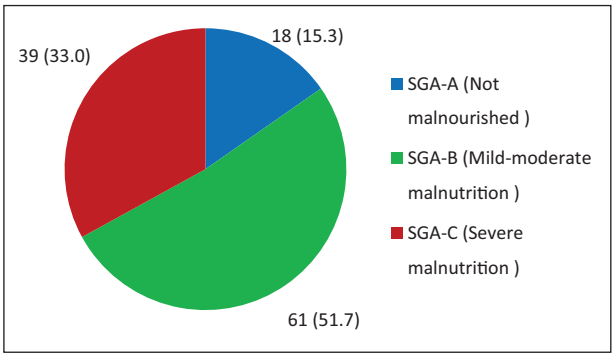

Figure 2. Classification of nutritional status according to SGA ($n = 118$).
SGA: subjective global assessment.

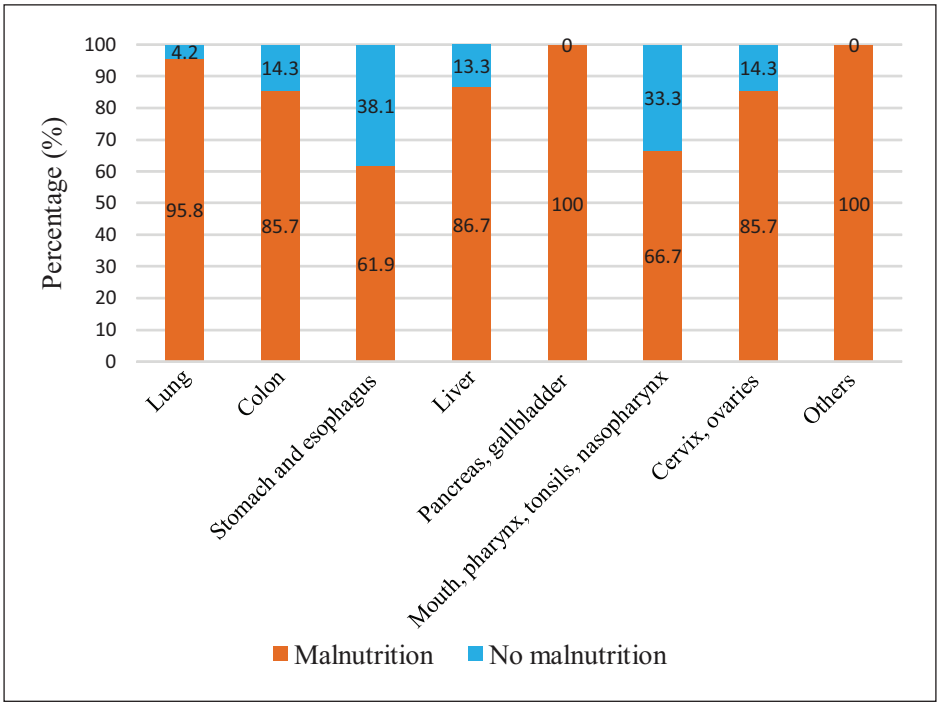

Figure 3. Rate of malnutrition in each group of cancer patients ($n = 118$).

school and lower, and 20.3% of patients have poor and near-poor economic status. This may be because people in rural areas were mostly economically disadvantaged, and with low education levels, they may have limited knowledge of disease prevention and therefore are also more susceptible to serious diseases. Besides, the study also show that there were four types of cancer accounting for the highest rate: lung (20.4%), colon (17.8%), stomach and esophagus (17.8%), and liver (12.7%). This result is consistent with the WHO report (2020) on cancer burden in Vietnam.[19]

The SGA tool was first published in 1987 by Desky, to assess clinical nutritional status and aid in the prediction of nutrition-related clinical outcomes such as mortality and hospital stays.[11] This tool has been successfully applied as a method of assessing nutritional status and predicting outcomes in hospitalized patients, including cancer patients.[11,20,21] Our results showed that the malnutrition rate of cancer patients was 84.8%, of which 33.0% were severely malnourished (SGA-C) and 51.7% had mild–moderate malnutrition (SGA-B). This result was similar to some studies which were also performed on inpatient cancer patients at the hospital such as Nguyen Thi Thanh Hoa (2018) in esophageal cancer at Tan Trieu Cancer Hospital, Vietnam using patient-generated SGA (PG-SGA) showing that rate of malnutrition was 82.5%,[22] and Ngo Thi Linh et al. (2020) showed that malnutrition rate of gastrointestinal cancer patients after surgery is 85.6%.[15] And Nguyen Thi Thuy Luong (2021) showed that, at a cancer hospital, in Hanoi, Vietnam, the rate of cancer patients suffering from malnutrition was 72%.[23] In addition, Bauer et al. (2003) in Australia also showed that the rate of hospitalized cancer patients with malnutrition assessed was 75% (SGA-C 12% and SGA-B 63%).[24] However, our result is higher than Trinh Hong Son et al.'s (2013) study results with 48% of gastric carcinoma patients at Viet Duc Hospital, Vietnam being malnourished including 4% SGA-C and 44% SGA-B.[25] Gupta et al.'s (2005) study on colorectal cancer patients showed that the rate of malnutrition was 48.3% (SGA-C 16.2%, SGA-B 32.1%).[26] This may be because most of the patients in our study who are undergoing inpatient treatment at the hospital have a serious condition, with comorbidities that are difficult to control their nutritional status.

Our study shows that the rate of malnutrition in different types of cancer is quite high. In which, malnutrition is highest in the group of cancers of the pancreas, gallbladder, lung, liver, and colon. This finding was similar to Dewys et al., with the highest rates of weight loss seen in cancer patients with solid tumors of pancreas, lung, colorectal, the stomach, and head and neck.[27] According to the study of Wie et al.[28] patients with liver cancer and lung cancer have higher rates of malnutrition than other cancers.

However, the special thing in our study found that esophageal and stomach cancer had the lowest rate of malnutrition (61.9%). This finding differs from the study by Hébuterne et al.[29] showing that esophageal and stomach cancers are the second most malnourished after pancreatic cancer, although the prevalence of malnutrition is similar to our study (60%).[29] This may be because the Hébuterne study was conducted with a larger sample size (1903 cancer patients) and performed at multiple centers (154 French hospital wards). In addition, Hébuterne's criteria for malnutrition are also

Table 6. Factors associated with malnutrition in cancer patients ($n = 118$).

Factors	Malnutrition		p_1	OR crude 95% CI	p_2	OR multivariable adjusted 95% CI
	Yes *n* (%)	No *n* (%)				
Age (years)						
<60	32 (88.9)	4 (11.1)	0.407*	1		
⩾60	68 (82.9)	14 (17.1)		0.61 (0.13–2.15)		
Sex						
Male	59 (81.9)	13 (18.1)	0.290*	1		
Female	41 (89.1)	5 (10.9)		1.81 (0.55–6.95)		
Accommodation						
Rural	66 (88.0)	9 (12.0)	0.194*	1	0.522	1
Urban	34 (79.1)	9 (20.9)		0.52 (0.16–1.62)		0.64 (0.16–2.50)
Education level						
⩽Primary school	62 (82.7)	13 (17.3)	0.807**	1		
Junior high school	22 (88.0)	3 (12.0)		1.54 (0.40–5.90)		
⩾High school	15 (88.2)	2 (11.8)		1.57 (0.32–7.72)		
Economic status						
⩽Poor and near poor	21 (87.5)	3 (12.5)	1.000**	1		
⩾Afford and well-off	79 (84.0)	15 (16.0)		0.75 (0.13–3.04)		
Hypertension						
No	66 (82.5)	14 (17.5)	0.325*	1		
Yes	34 (89.5)	4 (10.5)		1.80 (0.51–8.07)		
Diabetes						
No	88 (84.6)	16 (15.4)	1.000**	1		
Yes	12 (85.7)	2 (14.3)		1.09 (0.21–10.95)		
Gastrointestinal symptoms lasting 2 weeks						
No	57 (79.2)	15 (20.8)	0.035*	1	0.037	1
Yes	43 (93.5)	3 (6.5)		3.77 (0.76–21.39)		6.10 (1.12–33.35)
Reduced motor function						
No	38 (71.7)	15 (28.3)	<0.001**	1	0.002	1
Yes	62 (95.4)	3 (4.6)		8.16 (2.08–46.01)		13.73 (2.56–73.86)
Stress						
No	14 (63.6)	8 (36.4)	0.006**	1	0.131	1
Yes	86 (89.6)	10 (10.4)		4.91 (1.40–16.47)		3.07 (0.71–13.19)
BMI						
$>18.5\,kg/m^2$	41 (77.4)	12 (22.6)	0.044*	1	0.489	1
$\leqslant 18.5\,kg/m^2$	59 (90.8)	6 (9.2)		2.89 (0.90–10.05)		1.63 (0.41–6.42)
Albumin						
⩾35 g/l	24 (68.6)	11 (31.4)	0.002*	1	0.011	1
<35 g/l	76 (91.6)	7 (8.4)		4.98 (1.54–16.71)		6.42 (1.54–26.82)
Lymphocyte						
$>1700\,cells/mm^3$	36 (76.6)	11 (23.4)	0.045*	1	0.020	1
$\leqslant 1700\,cells/mm^3$	64 (90.1)	7 (9.9)		2.79 (0.89–9.22)		5.36 (1.31–21.97)

BMI: body mass index; CI: confidence interval; OR: odds ratio.
*Chi-square test.
**Fisher's exact test.
p_1: *p* Value univariate analysis.
p_2: *p* Value logistic multivariate analysis.

different from our study, which is a BMI $< 18.5\,kg/m^2$ in patients <75 years old or $<21\,kg/m^2$ in patients ⩾75 years old and/or body loss >10% since disease onset.

In addition, our results also show that 39.8% of patients have gastrointestinal symptoms. In which, the common symptoms were nausea (23.7%), anorexia (19.5%), and vomiting (15.3%). According to a study by Sánchez-Lara et al.[12] also found that the most common gastrointestinal symptoms reported in all cancer patients undergoing chemotherapy were nausea (59.6%) and anorexia (46%). Similar to other studies, these are also common gastrointestinal symptoms in cancer patients.[30–32]

Gastrointestinal symptoms that occur due to the tumor and due to the effects of chemotherapy are to reduce the patient's diet, causing lack of energy and leading to malnutrition.[33] The results of our multivariate regression analysis also showed that people with gastrointestinal symptoms lasting 2 weeks were 6.10 times more likely to have malnutrition than those without symptoms (OR: 6.10, 95% CI: 1.12–33.35). According to Sánchez-Lara et al.[12] gastrointestinal symptoms can influence weight loss in cancer patients and they should be included in early nutritional assessment.

Besides, our study also showed that there were 55.1% of patients with reduced motor function. In which, the percentage of patients who have to lie completely on the bed were 33.1%. Patients with reduced motor function were 13.73 times more likely to be malnourished than those without reduced motor function (OR: 13.73, 95% CI: 2.56–73.86). Similar to Detsk et al.[11]'s study, there is a correlation between reduced motor function and nutritional status of patients.

In addition, albumin is also considered a useful biomarker to assess the status of malnutrition in patients. Our study showed that cancer patients with blood albumin <35 g/l had 6.42 times the risk of malnutrition compared with those with albumin $\geqslant 35$ g/l (OR: 6.42, 95% CI: 1.54–26.82). This result is the same to Kuzuya et al.'s study which also showed that 78.9% of patients with severe malnutrition had albumin <35 g/l, and this rate in the group of mildly malnourished patients was 64% and no malnutrition was only 22.8% ($p < 0.05$).[34] Similar to other studies, low albumin levels are also associated with patient malnutrition.[35,36] However, there is currently a controversy regarding the sensitivity of albumin in nutritional assessment because there are many factors other than nutrition that can influence the decline in albumin levels such as infection, inflammation, and liver disease.

Our results also show that patients with blood lymphocytes $\leqslant 1700$ cells/mm^3 have a 5.36 times higher risk of malnutrition than those with lymphocytes >1700 cells/mm^3 (OR: 5.36, 95% CI: 1.31–21.97). Similar to Gunarsa et al.'s (2011) study which showed that a decrease in the number of lymphocytes in the blood was related to the progression of malnutrition, morbidity, and mortality of hospitalized patients. In addition, it is strongly associated with mortality in the elderly.[37]

However, our study showed no association between malnutrition and BMI ($p > 0.05$). This result is also similar to Judith et al. (2003) who showed that the mean BMI of patients with mild, moderate, or severe malnutrition was 23.8 kg/m^2, and these patients had an average weight loss of 23.8 kg/m^2 Which is 6.9% in the previous 6 months. Malnourished cancer patients can have BMIs in the healthy range or even be overweight because body fat masks the loss of body mass.[24] According to Tangvik et al.'s[38] study, patients at risk of malnutrition still had normal BMI or were overweight. This shows that if only BMI is used to assess the nutritional status of cancer patients, many malnourished patients may be missed.

This study also showed no association between malnutrition and stress ($p > 0.05$). This result is different from Saka et al.'s[35] and Zhang et al.'s[39] study which show that malnourished people have a higher risk of depression than those who are not malnourished. This may be because depression is a more serious mental health condition than stress, which may be related to malnutrition.

In addition, our study also showed that there was no relationship between age, sex, accommodation, education level, economic status, hypertension, and diabetes with malnutrition in cancer patients as assessed by SGA ($p > 0.05$). This result is similar to Zhang et al.'s[39] study which also did not find an association between age, gender, race, ethnicity, and social support with malnutrition in cancer patients.[39] However, Silva et al. (2015) found that smokers or former smokers, low socioeconomic status, and age $\geqslant 60$ years were associated with an increased risk of malnutrition in cancer patients.[40] This may be due to different study sites and assessment tools. Silva et al.'s study conducted at northeastern Brazil, assessing malnutrition in cancer patients using the PG-SGA questionnaire, is different from our study.

To control for bias in the study, we followed the sampling principle. Data collectors are well trained to agree on data collection methods and interview questionnaires. An appropriate time to survey the patient without affecting the patient's treatment was chosen. Carefully, checked the data set as soon as it was collected to promptly supplement if information is missing.

Besides the obtained results, this study also has some limitations. First, the lack of information on the time the patient has had cancer, the stage of the disease, and the length of hospital stay because these variables were omitted during data collection. Second, the number of patients with each type of cancer is small, so the rate of malnutrition may not be representative for each type of cancer. Finally, the study has not been able to assess the nutritional status of cancer patients through the PG-SGA questionnaire. This questionnaire assesses many aspects and is more specific to the nutritional status of cancer patients; however, we do not have the human resources to carry out this assessment.

This study's results have provided some insight into the status of malnutrition among cancer patients at a provincial hospital in Vietnam. As a result, health managers will be able to better comprehend the existing situation and make informed decisions when developing health policies, and ensure that professionals are more aware of the dietary needs of cancer patients, as this will improve the effectiveness of cancer treatment.

Conclusion

The rate of malnutrition in cancer patients was quite high, so it is necessary to strengthen nutrition counseling and intervention for cancer patients, especially those who are often stressed, have reduced motor function, and have gastrointestinal symptoms. It

is necessary to conduct a study with a larger sample size using the PG-SGA questionnaire to assess the nutritional status of each type of cancer patients.

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Author contributions

NVT conceived and designed the study, supervised the data collection, and interpreted the results. LTNA designed the study, performed the data analysis, and drafted the manuscript. HTB, PCC, and DTH participated in designing the study, data analysis, and data interpretation, and editing the manuscript. All authors read and approved the final manuscript.

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Ethics approval and consent to participate

The study protocol and ethics were approved by the scientific and technical committee of Long An Provincial General Hospital (Decision No. 1017/QĐ-BVĐKLA). Participants were provided the study information and voluntarily participated, signed a consent form to participate. The information collected from the patient is confidential and used for study purposes only. Whether they agreed to participate in the study or did not affect their own treatment at the hospital.

Informed consent

Written informed consent was obtained from all subjects before the study.

Trial registration

Not applicable.

ORCID iDs

Ho Tat Bang https://orcid.org/0000-0002-6786-1644

Le Thi Ngoc Anh https://orcid.org/0000-0003-2886-337X

Supplemental material

Supplemental material for this article is available online.

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