

MALNUTRITION STATUS AND RELATED FACTORS IN GASTRIC CANCER PATIENTS UNDERGOING CHEMOTHERAPY TREATMENT AT HO CHI MINH CITY ONCOLOGY HOSPITAL

Nguyen Ngoc Bich¹, Pham Hoang Dao¹, Le Thi Diem Trinh¹
and Pham Duy Quang^{2,✉}

¹University of Medicine and Pharmacy at HCM city

²Nguyen Tat Thanh University

Chemotherapy is one type of systemic treatment for cancer that causes side effects on eating and energy supply, leading to weight loss and malnutrition. Detecting malnutrition early in gastric cancer patients plays a critical role in implementing an effective nutritional regimen that can improve their nutritional status, prevent weight loss, and enhance their ability to withstand and respond to chemotherapy. The cross-sectional study was performed on 95 patients in Ho Chi Minh City Oncology Hospital from October 2021 to June 2022. According to the PG-SGA, MUAC, and BMI, the percentage of malnutrition are 69.5%, 33.7%, and 31.6%, respectively. There is a statistically significant connection between malnutrition rate by PG-SGA with age categories, cancer treatment methods, side effects of chemotherapy, and anemia.

Keywords: Malnutrition, gastric cancer, chemotherapy, PG-SGA.

I. INTRODUCTION

Gastric cancer is the fifth-highest cancer incidence (estimated 1,089,103 new cases, 5.6% of all sites) and the fourth most common cancer in men, compared to lung, prostate and colorectum cancer. It is also the third most common cause of cancer mortality in the world (estimated 768,793 new deaths, 7.7% of all sites) and it affected more than 17,000 people in Vietnam in 2020.¹

Surgery is currently considered to be the only radical treatment. Since curative treatment options are unavailable, the focus has shifted towards managing cancer symptoms and enhancing survival rates through surgery, chemotherapy, and radiation. In cases of advanced gastric cancer, chemotherapy plays

a crucial role, given that the majority of patients with gastric cancer experiences metastasis.² Chemotherapy is a systemic therapy that can improve outcome of resectable gastric cancer with extended lymph node dissection.³ Gastric cancer survival rates have been increasing steadily due to better detection methods, more effective adjuvant therapies; palliative chemotherapy had demonstrated to prolong survival without compromising the quality of life in metastatic gastric cancer. But, the most common chemotherapy side effects associated with the gastrointestinal tract are taste changes, chemotherapy-induced nausea and vomiting, constipation, and diarrhea that affect the nutritional status of patients.⁴

Malnutrition is a common finding in cancer patients, especially in gastric cancer during tumor progression, and is reported as varying between 65% to 85%.^{5,6} Therefore, diagnosis and treatment of malnutrition are of critical importance in patients with cancer. Because

Corresponding author: Pham Duy Quang

Nguyen Tat Thanh University

Email: duyquanghmu@gmail.com

Received: 04/05/2023

Accepted: 28/05/2023

of the disease and the effects of anticancer therapies, many patients with cancer are at risk for malnutrition. The development of malnutrition during chemotherapy seems to be related to the appearance of complications. Malnutrition is associated with poorer prognosis and decreased quality of life.⁷ Better knowledge might allow explanation of the risk factors for malnutrition and their early detection, so that an adequate nutritional intervention can be considered to prevent deaths or readmissions.

The HCMC Oncology Hospital is a leading hospital in South Vietnam for diagnosing and treating cancer diseases. Therefore, this article aims to identify malnutrition status and related factors in gastric cancer patients undergoing chemotherapy treatment at HCMC Oncology Hospital in 2022. We also provided information or counseling in the high-risk groups.

II. METHODS

1. Population characteristics

Inclusion criteria:

Patients were diagnosed with gastric cancer, according to AJCC TNM 2017, at Department Of Internal Medicine 4, HCMC Oncology Hospital, age ≥ 18 years and agreeing to participate in the study.

Exclusion criteria:

Patients having physical or mental health issues who were unable to complete the survey or respondents who didn't complete the questionnaire.

The study was done during from October 2021 to June 2022.

2. Method

Sample size:

$$n = Z_{1-\alpha/2}^2 \times \frac{p(1-p)}{d^2}$$

n = the desired sample size from a large population size.

α : Level of significance, choose $\alpha = 0.05$

$Z_{1-\alpha/2}$ = two-tailed Z-score confidence level (1.96).

p = Population proportion (0.595).

d = Absolute error (0.1)

Sample size was calculated according to a study done at Thai Nguyen Central Hospital, Thai Nguyen province by Le Thi Van. The prevalence of malnutrition according to the PG-SGA among patients with gastrointestinal cancer who have chemotherapy was found to be 59.5%.⁸ So, setting the prevalence at 59.5% and the allowable error 5% of prevalence the sample size was calculated as 93. We recruited 95 patients in the research.

Sampling selection:

The participants were recruited by using convenience sampling method. All inpatients who met the inclusion criteria during the study period were included until the sample size was sufficient.

3. Research design

This research was a cross-sectional study.

4. Study process

Data collection techniques

Data were collected from two sources. The primary data source was responses of sampled respondents who were eligible for interviews and from their medical records. While conducting survey research, researchers collect data from face-to-face interviews. The patients were allowed enough time to respond to the questions to minimize recall bias while recollecting past events. With the sampling bias, the process was facilitated by a team of nutrition students and an experienced consultant oncologist conducting field surveys.

Research tools and measurement methods

Body mass index (BMI). The BMI was calculated using the weight of patients, expressed in kilograms divided by the height of patients, expressed in meters squared (kg/m^2). The World Health Organization (WHO) criteria were used to determine the nutritional status of patients:⁹

- + BMI \geq 25: overweight/obese
- + 18.5–24.99: normal
- + \leq 18.49 (chronic energy deficiency (CED)).

Mid-upper arm circumference (MUAC). MUAC was measured to the nearest 0.1 cm on the right arm midway between the acromion and olecranon processes of the ulna with the use of a steel or fiberglass tape over the survey 5 cycles. Mild to moderate malnutrition: when MUAC from 5 to 10th percentile; Severe malnutrition: MUAC < 5th percentile.¹⁰

Patient-Generated Subjective Global Assessment

Patient-generated SGA (PG-SGA) was adapted from SGA and developed specifically to assess malnutrition for cancer patients. All patients were assessed by PG-SGA scores that consisted of 3 sections. The first section, which was completed by the patients, comprised the following components: weight history, food intake, nutrition impact symptoms, and activities and function. The physician completed the professional component part including catabolic conditions increasing nutritional requirements, physical examination, nutritional requirements, and weight loss scoring. In the global assessment section, the PG-SGA scores were categorized as:¹¹

- + A: Well nourished.

+ B: Mild/moderately malnourished.

+ C: Severely malnourished.

Hemoglobin:

According to the WHO, diagnosis anemia when hemoglobin was < 130 g/L in men and was < 120 g/L in women.¹²

Anthropometry:

Body weight (BW; nearest 0.1 kg) and height (nearest cm) were measured while the patient was standing without shoes and wearing light clothes.

5. Data analysis

The collected data were coded, entered, and cleaned using Epi data version 3.1 software (Jens M. Lauritsen & Michael Bruus, Odense, Denmark). The data were analyzed using a statistical software program (STATA®, version 16.0, Texas, USA). Categorical variables were presented as frequencies and percentages using descriptive statistics. Odds ratios with 95% confidence intervals and p-values < 0.05 were used to determine the strength of the association between dependent and independent variables. X² test was used to compare differences in categorical data. Bivariate correlation analysis (Spearman's R) was performed to show the correlation between SGA grades and other nutritional parameters.

6. Ethics Statement

The present study was reviewed and has been approved by the Institute Ethics Committee of University of Medicine and Pharmacy at Ho Chi Minh city (HCMC) (Ref. No.: 346/HDDD-DHYD; 29.03.2022) and the Institute Ethics Committee of HCMC Oncology Hospital (Ref. No.: 194/BVUB-HDDD; 17/05/2022).

III. RESULTS

Table 1. Clinical characteristics of the patients (n=95)

Characteristics		n	%
Gender	Male	61	64.2
	Female	34	35.8
Age (years)		57.2 ± 8.8	
Age categories	< 60 years	50	52.6
	≥ 60 years	45	47.4
Education background	Elementary or less	16	16.8
	Secondary education	45	47.4
	High school	23	24.2
	Higher education	11	11.6
Occupation	Farmer	18	18.9
	Worker	8	8.4
	Government employee	5	5.3
	Trader	3	3.2
	Self employee	22	23.1
	Housewife	16	16.8
Therapy	Retiree	23	24.2
	Chemotherapy	30	31.6
	Surgery-Chemotherapy	64	67.4
	Surgery-Chemotherapy-Radiation	1	1.0
Tumor stage	I	1	1.0
	II	6	6.3
	III	43	45.3
	IV	45	47.4
Frequency of chemotherapy	Initial time	17	17.9
	≥ 2 times	78	82.1
Weight change	Weight gain	29	30.6
	Weight stable	8	8.4
	Weight loss < 5%	34	35.8
	Weight loss ≥ 5%	24	25.3

The majority (64.2%, n = 61/95) of the respondents were male. The study showed that the patient's age ranged from 36 to 75 years, with the most common range belonging to the age group of < 60 years (52.06%) and the mean age of 57.2 ± 8.8 years. The rate of secondary education among them is the highest, at 47.4%. The rates of patients are highest (24.2%) among retirees and lowest (3.2%) among trader. The most common treatment method is

a combination of surgery and chemotherapy, accounting for 67.4%. Specifically, most cases of stomach cancer are diagnosed at a late stage, with 45.3% in stage III and 47.4% in stage IV, respectively, being the most frequent. The majority of patients had over two cycles of chemotherapy (82.1%). Overall, 61.1% of body weight decreased during chemotherapy and 25.3% had weight loss greater than 5%.

Table 2. Comparison of nutritional indicators

Nutritional assessment techniques		n	%
Subjective parameter PG-SGA	A	29	30.5
	B	31	32.6
	C	35	36.9
BMI	Overweight/Obesity (≥ 25)	3	3.2
	Normal weight (18.5-24.9)	60	63.1
	Underweight (< 18.5)	32	33.7
MUAC	Normal (> 10 th percentiles)	65	68.4
	Mild to moderate malnutrition (5-10 th percentiles)	17	17.9
	Severe malnutrition (< 5 th percentiles)	13	13.7

Using evaluation of nutritional status by PG-SGA, the study showed that 69.5% of patients suffered from malnutrition. PG-SGA was significantly increased for SGA-C patients (n = 35; 36,9%), followed by SGA-B (n = 31; 32.6%) and SGA-A (n = 29; 30.5%). According to BMI and MUAC, 33.7% and 31.6% of patients were at malnourished.

Table 3. Correlation between anthropometry, laboratory assessment and PG-SGA (n=95)

Anthropometry	PG-SGA (rho)	p**
Weight	-0.2800	0.0060
Height	0.0554	0.5941
BMI	-0.3804	0.0001
MUAC	-0.3478	0.0006
Hemoglobin	-0.2669	0.0089

** Spearman's correlation

Weight, BMI, MUAC and hemoglobin were negatively correlated with the PG-SGA (r= 0.2800; r = -0.3804, r = -0.3478, and r = -0.2669, p < 0.05, respectively).

Table 4. P-values for patient data, odds ratio (OR) and 95% Confidence Intervals (95% CI) of factors associated with malnutrition assessed with PG-SGA

Characteristics	Malnutrition				p*	OR (95% CI)	
	Yes		No				
	n	%	n	%			
Gender	Male	44	72.1	17	27.9	0.454	1.41 (0.57-3.49)
	Female	22	64.7	12	35.3		
Age categories	60 years	38	84.4	7	15.6	0.003	4.27 (1.51-12.02)
	< 60 years	28	56.0	22	44.0		
Type of treatment	Chemotherapy and combined therapy	50	76.9	15	23.1	0.021	2.92 (1.12-7.56)
	Chemotherapy	16	53.3	14	46.7		
Side effects of chemotherapy	Yes	48	75.0	16	25.0	0.008	4.13 (1.33-12.76)
	No	8	42.1	11	57.9		
Anemia	Yes	58	74.4	20	25.6	0.028	3.26 (1.07-9.94)
	No	8	47.1	9	52.9		
Tumor stage	V	32	71.1	13	28.9	0.744	1.16 (0.48-2.80)
	I, II, III	34	68.0	16	32.0		

*Chi-squared test

Associations between malnutrition and age categories showed that strongest among patients with ≥ 60 years, 4.27 times more likely to malnutrition compared to patients with < 60 years (OR = 4.27, 95% CI = 1.51-12.02, p-value = 0.003). Similarly, patients in chemotherapy and combined therapy were 2.92 times more likely subjected to malnutrition compared to patients with chemotherapy as mono-therapy

(OR = 2.92, 95% CI = 1.12-7.56, p-value = 0.021). Also, those with side effects of chemotherapy were 4.13 times more likely to have malnutrition than those with no side effects (OR = 4.13, 95% CI 1.33-12.76). Furthermore, adult cancer patients with malnutrition were 3.26 times more likely to have anemia than those who were well nourished (OR = 3.26, 95% CI 1.07-9.94).

Table 5. Logistic regression analysis of risk factors of patient characteristics with malnutrition among gastric cancer patients assessed with PG-SGA

Characteristics		p-value	Unadjusted OR (95% CI)	p-value ^a	AOR (95% CI)
Age categories	≥ 60 years	0.003	4.27 (1.51-12.02)	0.004	4.27 (1.60-11.37)
	< 60 years				
Type of treatment	Chemotherapy and combined therapy	0.021	2.92 (1.12-7.56)	0.023	2.92 (1.16-7.32)
	Chemotherapy				
Side effects of chemotherapy	Yes	0.008	4.13 (1.33-12.76)	0.010	4.13 (1.41-12.05)
	No				
Anemia	Yes	0.028	3.26 (1.07-9.94)	0.032	3.26 (1.11-9.60)
	No				

^a: Variables with p = 0.2 were excluded from the model; AOR: Adjusted Odds Ratio

In the multivariable logistic regression model, variables such as age categories, type of treatment, side effects of chemotherapy and anemia were significantly associated at p-value < 0.05.

IV. DISCUSSION

The study results showed 64.2% of gastric cancer occurred in men with the mean age of 57.2 ± 8.8 years. This result was consistent with the epidemiology of this disease. Gastric cancer is in the older age groups in most countries, as it is commonly diagnosis in the age group of 50 to 70 years for both men and women.¹³ The rates of disease are consistently higher in males than in females and, excluding the estimates for Katherine D Crew, the male:female ratio for gastric cancer varies from 2:1. The results of our research are in line with this study (1.8:1).¹³ On average, 92.7% of cases are diagnosed at stage III and IV. In particular, 47.4% of cancer patients in the current study are diagnosed at a very late stage. Moreover, it was consistent with a study done in Ha Noi that showed that 96% of patients are diagnosed with late-stage diagnosis.¹⁴ Delayed diagnosis and treatment

of gastric cancer, especially in development countries, are often associated with poor prognosis and account for the significant differences in the mortality rate.

Based on the results of PG-SGA, 30.5%, 32.6%, and 36.9% patients were classified into well nourished group (SGA-A), mildly to moderately malnourished group (SGA-B), and severely malnourished group (SGA-C), respectively. Apart from that, 69.5% of patients suffered from malnutrition. This is lower than a study done in the National Cancer Hospital, 48% of patients had malnutrition according to BMI, 94% of patients were at risk of malnutrition according to PG-SGA.¹⁴ This difference may be due to the financial status of the participants and the difference in different treatment interventions to improve the health status of patients. Another study conducted at Hanoi Medical University Hospital reported that 51.7% of cancer patients suffer from malnutrition, as classified by PG-SGA, and 20% of patients were malnourished based on the BMI.¹⁵ The difference in prevalence of malnutrition with our study might arise

from recruited participants having many types of cancer. In general, individuals with gastrointestinal cancer exhibit a higher prevalence of malnutrition when compared to other types of cancers. In addition, our results and another study by Nguyen Thi Thuy et al. showed that most of the patients are diagnosed with late-stage diagnosis which accounted for a higher percentages of patients with malnutrition in comparison with international studies. These results are consistent with the evidence that stage of cancer was found to be significant factors for malnutrition among cancer patients who receive chemotherapy.^{14,16}

In Table 3, it was found through a one-way analysis of variance that PG-SGA grade had a correlation with other nutritional parameters. Weight, BMI, MUAC, and hemoglobin were correlated with the PG-SGA ($p < 0.05$). A study from Shanghai, China showed that SGA grade was significantly correlated with the percentage of weight loss, BMI, triceps skinfold thickness, albumin, and prealbumin.¹⁷ Basically, when the PG-SGA grade classified the patients as more severely malnourished, the value of the other nutritional parameters, such as BMI, weight, MUAC, and hemoglobin, was lower. PG-SGA is a more sensitive tool than BMI and MUAC and is successfully used as a screening tool for malnutrition in diseases like cancer. Another study by Jae Won Cho et al. found that high PG-SGA scores at 2 months after gastrectomy were associated with an increased risk of mortality.¹⁸

Our analysis reveals patients aged 60 years or above were 4.27 times more likely to have malnutrition than those under 60 years old (AOR = 4.27, 95%CI 1.60-11.37). Although there are different ways to classify elderly adults, a multicentre study by Qi Zhang et al. identified malnutrition in 31.5% of patients with the same assessment tool.¹⁹ Many studies have

shown that body composition changes with aging, impairment of taste and smell, dental health status and dysphagia is recognized as a health problem of the elderly population.^{20,21} Malnutrition in elderly people is therefore a consequence of somatic, psychic or social problems. Typical causes are depression, social deprivation and loneliness. Elderly individuals are more prone to malnutrition compared to younger adults.²²

The type of treatment was significantly associated with malnutrition. Patients with combination therapy (especially surgery) were 2.92 times more likely to have malnutrition than those with simple chemotherapy ($p=0.021$). This may be due to alteration of the anatomy and physiology of the digestive system. Undoubtedly, those who have undergone gastric surgery suffer acute surgical stress and abrupt changes to dietary habits and lifestyle. Patients who have undergone gastric surgery may experience nutritional deficiencies due to impaired nutrient absorption and/or reduced food intake, which can result in the development of conditions such as anemia, osteoporosis and significant deficiency of vitamins.²³ Besides, Dumping syndrome, a common complication of esophageal, gastric or bariatric surgery, patients with severe dumping often limit their food intake to avoid undesired symptoms. This may lead to weight loss and eventually malnutrition.²⁴ Moreover, chemotherapy can also affect the gastrointestinal tract (nausea, vomiting, constipation, and diarrhea, fatigued,...). This result is similar to the study results of Tuemay Kiros Gebremedhin et al, loss of appetite ($p = 0.011$) and diarrhea ($p < 0.001$) among adult cancer patients receiving chemotherapy in Ethiopia were significantly associated with malnutrition.¹⁶

Regarding anemia and malnutrition in advanced gastric cancer, from the current

results, those with malnutrition were 3.26 times more likely to have anemia than those with no malnutrition (AOR = 3.26, 95%CI 1.11-9.60). There is a high occurrence of anemia among patients with advanced gastric cancer, and it exhibits significant variability, typically ranging from 10% to 30%.²⁵ The main reason for functional iron deficiency usually results from the malabsorption of iron because a lack of acidity results in a surgically altered gastrointestinal tract and impaired conversion of ingested ferric iron to absorbable ferrous iron. Besides, cancer-related appetite loss and bleeding also caused insufficient iron intake. In a study conducted by Chul-Hyun Lim al. in South Korea on 161 patients undergoing gastrectomy for gastric cancer, anemia occurred in 24.5% at three months after surgery and increased to 37.1% at 48 months after surgery, and iron deficiency was the primary cause of anemia.²⁶

Our study had some limitations. One major restriction of our research was the patient underwent several rounds of chemotherapy during treatment, and the nutritional status varied greatly, while the study was only evaluated at one point. Second, a cross-sectional study cannot determine causality for any of the study's associated factors.

V. CONCLUSION

The prevalence of malnutrition among gastric cancer patients receiving chemotherapy, as measured by the PG-SGA was 69.5%, BMI was 33.7%; MUAC was 31.6%. Age categories, types of cancer treatment, side-effects of chemotherapy, and anemia was found to be significant factors for malnutrition. Patients over the age of 60, those who have undergone gastrectomy, or those with anemia who are undergoing chemotherapy should receive

heightened focus on nutrition counseling.

REFERENCES

1. Sung H, Ferlay J, Siegel RL, et al. Global Cancer Statistics 2020: GLOBOCAN Estimates of Incidence and Mortality Worldwide for 36 Cancers in 185 Countries. *CA: A Cancer Journal for Clinicians*. 2021; 71(3): 209-249. doi:10.3322/caac.21660.
2. Liu GF, Tang D, Li P, et al. S-1-based combination therapy vs S-1 monotherapy in advanced gastric cancer: A meta-analysis. *World J Gastroenterol*. 2014; 20(1): 310-318. doi:10.3748/wjg.v20.i1.310.
3. Orditura M, Galizia G, Sforza V, et al. Treatment of gastric cancer. *World J Gastroenterol*. 2014; 20(7): 1635-1649. doi:10.3748/wjg.v20.i7.1635.
4. Grant M, Kravits K. Symptoms and their impact on nutrition. *Semin Oncol Nurs*. 2000; 16(2): 113-121. doi:10.1053/on.2000.5738.
5. Rosania R, Chiapponi C, Malfertheiner P, Venerito M. Nutrition in Patients with Gastric Cancer: An Update. *Gastrointest Tumors*. 2016; 2(4): 178-187. doi:10.1159/000445188.
6. Gavazzi C, Colatruglio S, Sironi A, Mazzaferro V, Miceli R. Importance of early nutritional screening in patients with gastric cancer. *Br J Nutr*. 2011; 106(12): 1773-1778. doi:10.1017/S0007114511002509.
7. Arends J, Bachmann P, Baracos V, et al. ESPEN guidelines on nutrition in cancer patients. *Clin Nutr*. 2017; 36(1): 11-48. doi:10.1016/j.clnu.2016.07.015.
8. Le Thi V, Nguyen Van Q, La Van L. Nutrition status and some related factors in the patient with gastrointestinal cancer who have chemotherapy treatment in the Oncology Center, Thai Nguyen National Hospital. *Tạp chí Y dược học Cần Thơ*. (34): 54-60.
9. Centers for Disease Control and

Prevention. *National Health and Nutrition Examination Survey (NHANES): Anthropometry Procedures Manual*. CreateSpace Independent Publishing Platform; 2014.

10. Yonei Y, Miwa Y, Hibino S, et al. Japanese Anthropometric Reference Data - Special Emphasis on Bioelectrical Impedance Analysis of Muscle Mass. *ANTI-AGING MEDICINE*. 2008; 5: 63-72. doi:10.3793/jaam.5.63.

11. Bauer J, Capra S, Ferguson M. Use of the scored Patient-Generated Subjective Global Assessment (PG-SGA) as a nutrition assessment tool in patients with cancer. *Eur J Clin Nutr*. 2002; 56(8): 779-785. doi:10.1038/sj.ejcn.1601412.

12. World Health Organization. Nutritional anemia: report of a WHO Scientific Group. *World Health Organ Tech Rep Ser*. 1968; 405: 1-40.

13. Crew KD, Neugut AI. Epidemiology of gastric cancer. *World J Gastroenterol*. 2006; 12(3): 354-362. doi:10.3748/wjg.v12.i3.354.

14. Thuy NT, Hương LT, Thanh NT. Nutritional status of gastric cancer patients during chemotherapy at Cancer Hospital in 2020 - 2021. *TCNCYH*. 2021; 146(10): 140-149. doi:10.52852/tcnycyh.v146i10.460.

15. Phuong DT, Huong LT, Linh NT, Yen DT. Nutritional status of cancer patients at HaNoi Medical University Hospital in 2016. *TCNCYH*. 2017; 106(1): 163-169. doi:10.52852/tcnycyh.v146i10.460.

16. Gebremedhin TK, Cherie A, Tolera BD, Atinafu BT, Demelew TM. Prevalence and risk factors of malnutrition among adult cancer patients receiving chemotherapy treatment in cancer center, Ethiopia: cross-sectional study. *Heliyon*. 2021; 7(6): e07362. doi:10.1016/j.heliyon.2021.e07362.

17. Wu BW, Yin T, Cao WX, et al. Clinical

application of subjective global assessment in Chinese patients with gastrointestinal cancer. *World J Gastroenterol*. 2009; 15(28): 3542-3549. doi:10.3748/wjg.15.3542.

18. Cho JW, Youn J, Kim EM, Choi MG, Lee JE. Associations of patient-generated subjective global assessment (PG-SGA) and NUTRISCORE with survival in gastric cancer patients: timing matters, a retrospective cohort study. *BMC Gastroenterol*. 2022; 22: 468. doi:10.1186/s12876-022-02515-3.

19. Zhang Q, Li XR, Zhang X, et al. PG-SGA SF in nutrition assessment and survival prediction for elderly patients with cancer. *BMC Geriatr*. 2021; 21: 687. doi:10.1186/s12877-021-02662-4.

20. Vranešić Bender D, Krznarić Ž. Nutritional issues and considerations in the elderly: an update. *Croat Med J*. 2020; 61(2): 180-183. doi:10.3325/cmj.2020.61.180.

21. Body composition changes with aging: The cause or the result of alterations in metabolic rate and macronutrient oxidation? - PMC. Accessed May 2, 2023. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2880224/>.

22. Pirlich M, Lochs H. Nutrition in the elderly. *Best Practice & Research Clinical Gastroenterology*. 2001; 15(6): 869-884. doi:10.1053/bega.2001.0246.

23. Miedziaszczyk M, Ciabach P, Szalek E. The Effects of Bariatric Surgery and Gastrectomy on the Absorption of Drugs, Vitamins, and Mineral Elements. *Pharmaceutics*. 2021; 13(12): 2111. doi:10.3390/pharmaceutics13122111.

24. Ukleja A. Dumping Syndrome: Pathophysiology and Treatment. *Nutrition in Clinical Practice*. 2005; 20(5): 517-525. doi:10.1177/0115426505020005517.

25. Hironaka S, Ueda S, Yasui H, et al. Randomized, open-label, phase III study

comparing irinotecan with paclitaxel in patients with advanced gastric cancer without severe peritoneal metastasis after failure of prior combination chemotherapy using fluoropyrimidine plus platinum: WJOG 4007 trial. *J Clin Oncol*. 2013; 31(35): 4438-4444.

doi:10.1200/jco.2012.48.5805.

26. Lim CH, Kim SW, Kim WC, et al. Anemia after gastrectomy for early gastric cancer: Long-term follow-up observational study. *World J Gastroenterol*. 2012; 18(42): 6114-6119. doi:10.3748/wjg.v18.i42.6114.