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Nutritional Status in Locally Advanced or Metastatic Solid Cancer Patients Treated With Chemotherapy, Radiotherapy, and Immunotherapy in Spanish Outpatient Oncology Units

Julio C. de la Torre-Montero[a,*,†], Jorgina Serra-López[b,†], Raquel Alvárez-García[c], Magdalena Battle-Vidal[d], Nieves Gil-Gómez[e], Patricia Beorlegui-Murillo[f], Dolores Pérez-Cárdenas[g], Andrés Sánchez-Belchiz[h], Erik Medina Cruz[i], Ángeles Peñuelas-Saiz[c], on behalf of the Spanish Society of Oncology Nursing Nutrition Group [‡]

[a] *Director of the Health Sciences Department, Spanish Society of Oncology Nursing; Universidad Pontificia Comillas; and Fundación San Juan de Dios, Madrid, Spain*
[b] *Medical Oncology Department, Spanish Society of Oncology Nursing, Madrid; and Hospital Santa Creu i Sant Pau, Barcelona, Spain*
[c] *Medical Oncology Department, Spanish Society of Oncology Nursing, Madrid; and Hospital Vall d'Hebrón, Barcelona, Spain*
[d] *Medical Oncology Department, Spanish Society of Oncology Nursing, Madrid; and Son Espases University Hospital, Palma de Mallorca, Spain*
[e] *Medical Oncology Department, Spanish Society of Oncology Nursing; and Hospital Universitario Quirón Pozuelo, Madrid, Spain*
[f] *Medical Oncology Department, Spanish Society of Oncology Nursing, Madrid; and Clínica Universitaria de Navarra, Navarra, Spain*
[g] *Medical Oncology Department, Spanish Society of Oncology Nursing; and 12 de Octubre University Hospital, Madrid, Spain*
[h] *Medical Oncology Department, Spanish Society of Oncology Nursing, Madrid; and Virgen del Rocío University Hospital, Sevilla, Spain*
[i] *Medical Oncology Department, Spanish Society of Oncology Nursing, Madrid; and Hospital Universitario de Canarias, Palmas de Gran Canaria, Spain*

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ABSTRACT

Objectives: Malnutrition is a prevalent condition in cancer patients that significantly impacts patients' clinical outcomes and health-related quality of life (HR-QoL). The outcome was to characterize the nutritional status by describing the prevalence of malnutrition (mild, moderate, or severe) and its risk in outpatient cancer patients.
Methods: Multicenter, prospective, cross-sectional, descriptive, two-cohort study conducted on consecutive adult patients with locally advanced or metastatic solid tumors (stages III-IV). The study was conducted in 10 Spanish hospitals distributed all over the Spanish geography, with a recruitment period of 5 months (between April and September 2020). Study patients were divided into two groups according to their cancer therapy: group A, patients who underwent immunotherapy, and group B, patients who received combined therapy (immunotherapy plus chemotherapy and radiotherapy).
Results: A total of 585 patients were included. The proportion of patients at risk of malnutrition was notably more significant in the combination group (chemotherapy and/or radiotherapy) than in the immunotherapy-only group (28.3% versus 58.5%, respectively, $P < .0001$). According to this evaluation the highest proportion of patients at risk were those with pancreatic cancer (51 patients; 89.5%), followed by large intestine cancer (52 patients; 55.3%) and lung cancer (56 patients; 29.3%), $P < .0001$.
Conclusions: Patients treated with only immunotherapy seemed to have better nutritional status, which indicated health-related quality of life improvement. Additionally, there was a trend associating nutritional status with tumor location. Treatment strategy, treatment duration, performance status, and treatment location were independently associated with malnutrition.
Implications for Nursing Practice: Integrating nutritional assessment into routine clinical practice will improve the quality of life of oncology patients. An integrative approach to health improves overall results in terms of nutritional status and improved quality of life and shows that daily living activities are more satisfactory for patients with nursing interventions. Nursing interventions are consistent with an educational approach to

* Address correspondence to Julio de la Torre-Montero, Universidad Pontificia Comillas, Escuela de Enfermería y Fisioterapia San Juan de Dios, Av. San Juan de Dios, 1, 28350, Ciempozuelos, Madrid, Spain.
E-mail address: juliodelatorre@comillas.edu (J.C. de la Torre-Montero).
† Julio C. de la Torre-Montero and Jorgina Serra-López contributed equally to this work and are considered co-first authors.
‡ Spanish Society of Oncology Nursing Nutrition Group members are given in this report/

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patients as long as the interventions described in international guidelines are detailed in the framework of the patient care.

Layperson Summary

What we investigated and why

We looked at the nutritional health of cancer patients in Spain who are receiving treatments like chemotherapy, radiotherapy, and immunotherapy. Malnutrition, or poor nutrition, is common in cancer patients and can worsen their health and quality of life. We wanted to see how many patients were at risk of malnutrition and how their treatment type affected their nutritional status.

How we did our research

We conducted a study involving 585 adult cancer patients from 10 hospitals across Spain. These patients had advanced or spread solid tumors and were divided into two groups based on their treatment: one group received only immunotherapy, and the other received a combination of immunotherapy with chemotherapy and/or radiotherapy. We assessed their nutritional status using specific tools designed to identify malnutrition risk.

What we have found

We discovered that patients receiving only immunotherapy had a better nutritional status compared to those receiving combination treatments. Specifically, 28.3% of patients on immunotherapy were at risk of malnutrition, while 58.5% of those on combination treatments were at risk. Pancreatic, large intestine, and lung cancer patients were more likely to be at risk of malnutrition.

What it means

Our findings suggest that cancer treatment type affects nutritional health, with immunotherapy being less likely to lead to malnutrition. This highlights the importance of regular nutritional assessments for cancer patients to improve their quality of life. By integrating nutritional care into routine practice, healthcare providers can better support cancer patients in maintaining their health and well-being during treatment.

Malnutrition is a common medical problem in oncology patients.[1,2] Between 15% and 40% of oncology patients show weight loss at diagnosis, and the incidence of malnutrition increases throughout the disease, reaching 80% of all patients with cancer. Patients with advanced cancer will develop cachexia throughout their disease, with the subsequent negative effect on function, treatment tolerance, and overall mortality. Moreover, clinical data suggest that about 20% to 30% of deaths are attributable to malnutrition rather than to cancer. Despite all this, diagnosing nutritional disorders and implementing treatment for these disorders are not perceived as necessary routine in clinical nursing practice.

It is well known that malnutrition negatively affects patients' evolution and quality of life, increasing the incidence of infection, hospital stay, and mortality.[1,3,4] In patients with cancer, nutrition and their nutritional status play an essential role in the efficacy and effectiveness of the treatments and, consequently, the patient's health-related quality of life (HR-QoL).[4,5]

New advances in cancer biology research have allowed the identification of different mechanisms of cancer progression, such as self-sufficiency in growth signals, insensitivity to antigrowth signals, evading apoptosis, no breaks in the replicate potential, and sustained angiogenesis.[6,7]

New treatment strategies have been developed that aim to reverse the antitumor capacity of the immune system. However, compared to traditional treatments (chemotherapy/radiotherapy), these new targeted therapies have different toxicities, such as alterations in glucose metabolism, endocrinopathies, rhabdomyolysis, etc., which are known to alter the patient's nutritional status and HR-QoL.[8,9] Additionally, a deficient nutritional status can affect the intestinal microbiota, compromising the efficacy of the new antitumor treatments.[10]

Different studies have evaluated the nutritional status in patients with cancer.[5,1,12] The PreMio study, a prospective, observational, and multicenter study conducted at 22 medical oncology centers across Italy, reported that among the 1,952 patients included, 51.1% of patients had a nutritional impairment, including the risk of malnutrition and over malnutrition. As determined by Mini Nutritional Assessment, 40.1% of patients without metastases (M0) already had poor nutritional status at their first oncology visit. Of these, 36.5% were at risk of malnutrition, and 3.5% were malnourished. Malnutrition was evidenced in 13.6%.[5] The results of a prevalence survey conducted in France found a high prevalence of patients with malnutrition (39%), and a high rate of those malnourished patients (42.4%) received no nutritional support.[11] Finally, the results of a cross-sectional, observational, multicenter study conducted at eight gastroenterology units in Romania showed that of all the patients evaluated (n = 3198) in nutritional risk, 31,3% were diagnosed with cancer as a principal diagnosis. The overall prevalence of malnutrition was 20.4%, and of them, 26.8% were oncologic patients.[12]

Two studies evaluated the nutritional status of cancer patients in Spain.[1,13] A multicenter study that included 781 patients with cancer reported that 52% of patients were moderately or severely malnourished and 97.6% of subjects required some form of nutritional intervention/advice.[13] The PREDyCES, an observational, cross-sectional, multicenter study conducted on patients with cancer, found that 33.9% of patients were at nutritional risk at admission and 36.4% of patients were at risk at discharge. This study also revealed that only one-third of at-risk patients received nutritional support.[1]

There is, therefore, the need to assess the impact of these new cancer therapies on the nutritional status of our patients. National registers allow a personalizing nutritional approach with special consideration for cultural and ethnographic particularities. This comprehensive study in Spain evaluates the relationship between nutritional status and different socioeconomic, demographic, and clinical characteristics in patients with cancer.

The current study aimed to assess the nutritional status, using the Spanish versions of the NUTRISCORE and Patient-Generated Subjective Global Assessment (PG-SGA),[14,15] in Spanish oncology outpatients who underwent treatment with immunotherapy, either alone or in combination with other targeted therapies. Although the relationship between cancer and nutritional status impairment has been widely analyzed, there are little data assessing the nutritional status of oncology outpatients, and, to our knowledge, none of them covers the analysis of the effects of new target therapies. The primary endpoint is to characterize the nutritional status of the oncology outpatient receiving either immunotherapies or any other targeted therapies through a screening performed at hospital consultations in Spain.

Methods

Study Design

A prospective, cross-sectional, multicenter, observational, single-visit, two-cohort study was conducted on adult patients with locally advanced or metastatic solid tumors. Nutritional status was assessed by using the Spanish versions of the NUTRISCORE and PG-SGA. These tools have been previously validated and published in the Spanish oncology population, and we believe that they are the most appropriate for our study. We used two nutrition tools that address the risk of malnutrition from different angles: (1) a score that allows the risk to be assessed from the patient's subjective point of view conducted by a health care professional and (2) an objective measure. In addition, we sought correlations between biometric, anthropometric, and social values as determinants of health, which allow for the best care for patients with cancer.

The NUTRISCORE is a malnutrition assessment tool that was developed specifically for patients with cancer and validated by reference to the PG-SGA. It consists of four parts: involuntary weight loss in the past 3 months and poor eating in the last week due to decreased appetite; tumor location/neoplasm; and oncology treatment. Patients who scored $\geq$5 points were classified as at risk.[14]

PG-SGA is commonly used in patients with cancer. It should be performed by a well-trained professional. The PG-SGA considers different parameters, including weight loss, diagnosis, current treatments, and medication taken, and biochemical parameters, such as albumin and prealbumin. In addition, the method considers the symptoms, diet, and patient's daily activity and requires physical examinations to detect decreased muscle mass, fat, and the presence of edema. PG-AGS classifies the patient as well-nourished, moderately, or suspiciously malnourished and severely malnourished.[4,15]

The study was conducted at 10 third-level oncologic centers representative of the Spanish national territory (including the mainland and the Canary and Balearic Islands) to have a homogeneous sample from all territories. A 3-month recruitment period was used to collect a sufficiently large target sample.

Study Population

The population consisted of adult patients with locally advanced or metastatic solid cancer (stages III or IV)[16] who underwent treatment with immunotherapy, either alone or in combination with chemotherapy or radiotherapy, as first-line treatment for a minimum of 12 weeks before being included in the study and who attended an outpatient hospital consultation of the oncology service.

Before the study, according to the data of the Spanish Network of Cancer Registries (REDECAN)[21] and based on the number of cancer diagnoses in 2019 in Spain, there will be an incidence of 277.234 new cases, with a prevalence of 772.853 cases (5-year projection); the sample size is 504, with expected losses of 15% final sample calculation, so 610 patients are required to estimate a proportion of 50%, assuming an α of 0.01 and a β error of 5.5%. It was proposed to stratify the sample in a proportion of 2:1 (group A:group B). With this population, we calculate a proportion estimation, with a confidence interval $1-\alpha$ of 99%, d = 3%, and P = .05.

The sample distribution was based on the data about the incidence of tumors published by the Spanish Society of Medical Oncology (SEOM)[22]—at least 50% are lung tumors, at least 20% are melanoma, and 30% are other tumors (eg, kidney, bladder, head and neck, miscellaneous).

Immunotherapy was defined by checkpoint treatment inhibitors programmed cell death protein 1, programmed death-ligand 1, and cytotoxic T-lymphocyte antigen 4.[17] The purpose of including only patients with locally advanced or metastatic solid tumors was to homogenize the sample as far as possible, as well as to perform a stratification in line with GLOBOCAN.[18]

Patients were excluded if they had any severe psychiatric disorder or an estimated survival of less than 12 weeks (palliative care criteria) or met the diagnostic criteria (*Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition* and *International Classification of Diseases 10*) of nervous anorexia and bulimia.[19]

Patient Visits and Study Variables

The study consisted of one visit in which sociodemographic and clinical variables were collected through the patient medical record or directly from the patient.

The different variables analyzed in the study included the sociodemographic, socioeconomic, and sociocultural characteristics of the sample; clinical characteristics of the tumor; type of cancer treatment; nutritional status (assessed by NUTRISCORE and PG-SGA); Eastern Cooperative Oncology Group (ECOG) performance status;[20] and nutritional therapy. Additionally, the diagnosis of severe acute respiratory syndrome coronavirus 2 was included in the assessment.

Study Groups

The study sample was divided according to the cancer treatment: group A patients underwent immunotherapy treatment for at least 12 weeks before study inclusion, and group B patients underwent combined treatment with immunotherapy plus chemotherapy and/or radiotherapy for at least 12 weeks before study inclusion.

Nutritional Status Assessment

Study Outcomes

Malnutrition is a prevalent condition in cancer patients that significantly impacts patients' clinical outcomes and health-related quality of life (HR-QoL). The primary outcome was to assess the nutritional status of outpatients with cancer receiving either immunotherapy alone or combined with other targeted therapies.

The secondary outcomes included the proportion of malnourished or patients at risk of malnutrition who received nutritional interventions (from nutritional counseling to medical nutrition treatment, either enteral or parenteral nutrition); an assessment of the sociodemographic characteristics, eating habits, sociocultural implications, and clinical characteristics of the primary tumor (type and TNM classification of malignant tumors); the relationship between nutritional status and different study variables (ie, age, sex, tumor type, tumor stage, socioeconomic status, treatment time, and ECOG performance status score); the proportion of malnourished or at-risk patients treated with either immunotherapy alone or in combination with chemotherapy and/or radiotherapy who received a nutritional treatment (nutritional advice [NA], oral nutritional supplements [ONS], enteral nutrition [EN], parenteral nutrition [PN], or a combination of treatments); and evaluation of the nutritional status of the study sample according to their sociodemographic and sociocultural characteristics.

Due to the epidemiologic characteristics of this study, investigators did not ask about adverse events or their potential relationship with specific drugs. Nevertheless, information about generic groups of agents or treatments was collected.

Statistical Analysis

Statistical analysis was performed with the statistical package SAS Enterprise Guide 7.15 (SAS Institute Inc, Cary, NC; https://www.sas.com). Descriptive statistics mean (standard deviation [SD]), median (interquartile range [IqR]), and number (percentage) were used as appropriate. No missing data have been imputed; only the available data were analyzed.

Comparative analyses were conducted using the Student t test in continuous variables and the chi-square test when analyzing categorical variables. For the comparison of more than two groups, the analysis of variance test was used.

To identify possible factors related to malnutrition in oncology outpatients, logistic regression analysis was performed. Factors associated with malnutrition in the univariate analysis at $P \leq .1$ were included in the multivariate analysis. A value of $P < .05$ was considered significant.

Ethics. This noninterventional study was carried out in accordance with the protocol and all applicable laws and regulations, including, among others, Guidelines for Good Pharmacoepidemiology Practices issued by the International Society for Pharmacoepidemiology and the ethical principles that have their origin in the Declaration of Helsinki and the applicable privacy laws. Data protection and privacy regulations were strictly adhered to when collecting, sending, processing, and storing patient data. The confidentiality of the participants was guaranteed in accordance with Directive 95/46/EC on the protection of natural persons and in accordance with the Safe Harbor Privacy Principles. An IEC reviewed and approved the protocol and informed consent form before enrolling any patients. Before carrying out any data collection indicated by protocol, the patient (or authorized legal representative) gave consent by signing and dating the informed consent form approved by the relevant IEC in each site. The study protocol was also approved by the ethics committees of the different centers participating and was registered in the ClinicalTrials.gov site with the registration number NCT04168814.

Results

A total of 585 patients—385 (65.8%) in group A and 200 (34.2%) in group B—were included in the study.

Demographic and Clinical Characteristics

In the overall study sample, the mean age was 63.4 ± 11.2 years and 234 (40.0%) were women. Mean body mass index (BMI) was 25.9 ± 4.7 kg/m^2 in the overall study sample, with 100 (17.2%) patients having a BMI of ≤30 kg/m^2. Mean (SD) BMI was 25.89 (4.71) kg/m^2; 4.5% of patients were underweight and 17.2% were obese (3.8% with a BMI >35 kg/m^2). Arm and calf circumferences were 27.99 (4.62) cm and 36.06 (4.49) cm, respectively. Results of dynamometry were similar in both groups of patients, being 30.12 (12.78) cm for group A, 30.34 (12.36) cm for group B, and 30.20 (12.63) cm for the total population. Table 1 shows the main demographic and clinical characteristics of the study sample. All patients were classified between ECOG 0 and 2, with more than half of the patients in ECOG 1 (358; 61.2%).

Table 1
Demographic and Clinical Characteristics of the Study Sample

	Overall (N = 585)	Group A (n = 385)	Group B (n = 200)	*P*[a]
Age, y				
Mean ± SD	63.4 ± 11.2	63.9 ± 11.1	62.4 ± 11.2	.1227
Range	26-89	26-89	26-88	
Sex, n (%)				
Women	234 (40.0)	153 (39.7)	81 (40.5)	.8593[b]
Men	351 (60.0)	232 (60.3%)	119 (59.5%)	
Race, n (%)				
Caucasian	454 (77.6)	301 (78.2)	153 (76.5)	.7669[c]
Asian	1 (0.2)	1 (0.3)	0 (0.0)	
Hispanic	126 (21.5)	81 (21.0)	45 (22.5)	
African	4 (0.7)	2 (0.5)	2 (1.0)	
Other	0	0 (0.0)	0 (0.0)	
BMI[1], kg/m[2]				
Mean ± SD	25.9 ± 4.7	26.0 ± 4.7	25.8 ± 4.8	.6283
Range	15.8-50.4	16.0-42.2	15.8-50.4	
BMI[1], kg[2]				
<18.5	26 (4.5)	17 (4.4)	9 (4.5)	.8108[c]
18.5-25	243 (41.6)	157 (40.9)	86 (43.0)	
25-30	215 (36.8)	143 (37.2)	72 (36.0)	
30-35	78 (13.4)	50 (13.0)	28 (14.0)	
>35	22 (3.8)	17 (4.4)	5 (2.5)	
Employment status, n (%)[2]				
Employed	57 (9.8)	40 (10.5)	17 (8.5)	.3564[c]
Unemployed	49 (8.4)	31 (8.1)	18 (9.0)	
Retired	328 (56.4)	222 (58.1)	106 (53.0)	
Temporary leave	148 (25.4)	89 (23.3)	59 (29.5)	
Educational level, n (%)[3]				
No formal education	30 (5.1)	23 (6.0)	7 (3.5)	.1473[c]
Primary education	214 (36.7)	132 (34.5)	82 (41.0)	
Secondary education	177 (30.4)	125 (32.6)	52 (26.0)	
University study/postgraduate studies	162 (27.8)	103 (26.9)	59 (29.5)	
Family situation, n (%)[1]				
Alone	72 (12.3)	47 (12.2)	25 (12.5)	1.0000
Accompanied	512 (87.7)	337 (87.8)	175 (87.7)	
NOFM[5]				
Mean ± SD	2.3 ± 1.1	2.2 ± 1.1	2.5 ± 1.1	.0001
Range	1-7	1-7	1-7	
LPT, n (%)				
Lung	191 (32.6)	166 (43.1)	25 (12.5)	<.0001
Pancreas	57 (9.7)	9 (2.3)	48 (24.0)	
Small intestine	6 (1.0)	5 (1.3)	1 (0.5)	
Large intestine	94 (16.1)	54 (14.0)	40 (20.0)	
Liver	10 (1.7)	4 (1.0)	6 (3.0)	
Bone	2 (0.3)	0 (0.0)	2 (1.0)	
Brain	5 (0.9)	4 (1.0)	1 (0.5)	

(*continued*)

Table 1 (*Continued*)

	Overall (N = 585)	Group A (n = 385)	Group B (n = 200)	P[a]
Melanoma	21 (3.6)	21 (5.5)	0 (0.0)	
Others*	199 (34.0)	122 (31.7)	77 (38.5)	
Initial cancer diagnosis**, n (%)[4]				
Stage III	135 (23.3)	83 (21.6)	52 (26.7)	.1773
Stage IV	445 (76.7)	302 (78.4)	143 (73.3)	
Time from diagnosis, y				
Mean ± SD	1.5 ± 1.8	1.8 ± 2.0	0.9 ± 1.2	<.0001
Range	0.2-14.7	0.2-14.7	0.2-9.5	
Degree of differentiation, n (%)[6]				
Well differentiated	225 (44.6)	89 (26.4)	55 (32.7)	.0601
Moderately differentiated	144 (28.5)	89 (26.4)	55 (32.7)	
Poorly differentiated	136 (26.9)	100 (29.7)	36 (21.4)	
ECOG status, n (%)				
ECOG 0	197 (33.7)	129 (33.5)	68 (34.0)	.6717
ECOG 1	358 (61.2)	234 (60.8)	124 (62.0)	
ECOG 2	30 (5.1)	22 (5.7)	8 (4.0)	
ECOG 3	0 (0.0)	0 (0.0)	0 (0.0)	
ECOG 4	0 (0.0)	0 (0.0)	0 (0.0)	
Comorbidities†, n (%)				
Yes	332 (66.8)	218 (56.6)	114 (57.0)	1.0000
No	253 (43.2)	167 (43.49	86 (43.0)	
Charlson Index				
Mean ± SD	4.2 ± 4.3	4.4 ± 4.4	4.0 ± 4.1	.2863
Range	0.0-16.0	0.0-16.0	0.0-15.0	

[1] Data available for 584 patients.
[2] Data available for 582 patients.
[3] Data available for 583 patients.
[4] Data available for 580 patients.
[5] Data available for 511 patients.
[6] Data available for 505 patients.
[a] Independen-samples two-way Student t test.
[b] Fisher exact test.
[c] Chi-squared test.
* Included: amygdala−epidermoid, signet ring cell; oral cavity; oral cavity−epidermoid carcinoma; cavum; cavum−neo; cervix; cervix−adenocarcinoma; cholangiocarcinoma; cholangiocarcinoma stage IV; colon−adenocarcinoma; gastric body; digestive−neuroendocrine; endometrium−adenocarcinoma; esophagus; gastric esophagus−union; esophagus−distal; stomach; pharynx; gastric; gastroesophageal−union; tongue−base; breast; and intracranial meningioma.
† Included: myocardial infarction; congestive heart failure; peripheral vascular disease; cerebrovascular disease; dementia; chronic obstructive pulmonary disease; connective tissue disease; peptic ulcer disease; liver disease (mild, moderate, and severe); diabetes mellitus (both uncomplicated and with end-organ damage); hemiplegia; moderate to severe renal disease; solid tumor (both localized and metastatic); leukemia; lymphoma; and acquired immune deficiency syndrome.
** Time since diagnosis of solid tumor.
Group A, patients who underwent treatment with immunotherapy alone; group B, patients who underwent treatment with immunotherapy plus chemotherapy and/or radiotherapy.
Abbreviations: SD, standard deviation; BMI, body mass index; NOFM, number of family members; LPT, location of primary tumor; ECOG: Eastern Cooperative Oncology Group performance status.

The results of the NutriScore and PG-SGA showed a statistical relationship with the ECOG scale. Among patients with ECOG 0, 31.5% had a NutriScore score ≥5 (risk), and this percentage was higher than 40% in patients with ECOG 1 or 2 ($P = .039$). The highest percentage of severely or moderately or suspiciously malnourished patients were ECOG 2 (14 [46.7%]), 24.6% were ECOG 1, and 9.7% were ECOG 0 ($P < .0001$).

In total, 332 (56.8%) patients presented with some type of comorbidity. The most frequent comorbidity after metastatic solid tumor (localized), present in 12.6% of patients, was uncomplicated diabetes mellitus in 96 (16.4%) patients. The mean (SD) Charlson Comorbidity Index score was 4.21 (4.29) with an estimated 10-year survival of 50.93 (46.32), with no differences between groups ($P = .2863$).

There were significant differences between groups A and B in the number of family members (greater in group B, $P = .0001$), location of primary tumor (greater proportion of lung cancer in group A, $P < .0001$), and time from diagnosis (longer in group A, $P < .0001$).

There was a great heterogeneity regarding TNM classification; T3N1M1 was the classification that concentrates a greater number of patients 67 (11.5%).

Regarding treatments, in group A, 191 (49.6%) patients were treated with checkpoint inhibitors and 167 (43.4%) with monoclonal antibodies. In group A, 197 (51.2%) patients were cotreated with chemotherapy, 30 (7.8%) with radiotherapy, and 18 (4.7%) had undergone surgery. All patients in group B were cotreated with chemotherapy; 16 (8.0%) with radiotherapy; 10 (5%) had undergone surgery, and 10 (5%) patients were cotreated with growth factors.

Nutritional Status

NUTRISCORE

According to NUTRISCORE, 226 (38.6%) patients were at nutritional risk (score ≥5), 109 (28.3%) in group A and 117 (58.5%) in group B; the mean difference was −30.2 (95% CI −38.1% to −21.8%, $P < .0001$).

In the overall study sample, the mean NUTRISCORE was 4.3 ± 1.2. The NUTRISCORE was significantly lower in group A (4.0 ± 1.1 points) than in group B (4.8 ± 1.1); the mean difference was −0.8 ± 1.1 points (95% CI −1.0 to -0.6; $P < .0001$, independent-samples two-way Student t test).

Mean NUTRISCORE was greater in patients treated with chemotherapy alone (4.8 ± 1.1, points, with 107 [58.2%] patients at risk of malnutrition) than in patients in targeted therapy (4.2 ± 1.2 points, with 66 [34.7%] patients at risk of malnutrition) and patients treated with immunotherapy (3.9 ± 1.0 points, with 43 [22.1%] patients at risk of malnutrition; $P < .0001$ each, respectively). No significant differences were observed between targeted and immunotherapy patients ($P = .3745$).

PG-SGA

In the overall study sample, the mean PG-SGA was 5.3 ± 4.0. It was significantly lower in group A (4.8 ± 3.7 points) than in group B (6.1 ± 4.4 points; mean difference −1.3 ± 4.0 points; 95% CI −2.0 to −0.6; $P = .0002$ independent-samples two-way Student t test). In both groups, the main reason for nutritional therapy was problems that affected eating (State A, 59 [59.0%] and State B or C, 26 [44.1%]). In the case of "Changes in body weight" and "Changes in the amount and time of food consumed," the percentage of patients was higher in State B/C patients than State A patients ($P < .05$).

According to treatment, a greater proportion of patients were classified as "Moderately or suspiciously malnourished" in group B (64; 32.0%) than in group A (56; 14.6%; mean difference 17.4%; 95% CI 10.2% to 24.9%, $P < .0001$).

NUTRISCORE

In the overall study sample, 160 (27.4%) were receiving nutritional treatment—81 (21.0%) patients in group A and 79 (39.5%) in group B ($P < .0001$).

Of the total patients on nutritional therapy, 123 (76.9%) were on NA—69 (43.1%) were taking ONS, 11 (6.9% were taking EN), and 1 (0.6%) was taking PN.

Among the patients with NUTRISCORE <5, a greater proportion of patients were receiving nutritional therapy in group B than in group A (difference 13.2%; 95% CI 3.5% to 24.3%, $P = .0056$), although there were no differences regarding the type of nutritional therapy.

In the patients with a NUTRISCORE ≥5, no significant differences were observed between groups in the proportion of patients who were taking nutritional therapy (difference 10.3%; 95% CI −2.6% to 22.7%, $P = .1188$).

PG-SGA

Of the total of 584 patients who completed the questionnaire, 121 (20.7%) were classified as "Severely or Moderately or Suspiciously malnourished." Among them, 59 (48.8%) were taking some kind of nutritional therapy. Among those patients classified as "Well nourished," there was a greater proportion of patients receiving nutritional therapy in group B than in group A (difference 12.4%; 95% CI 4.0% to 21.4%, $P = .0033$), although there were no differences regarding the type of nutritional therapy. Similarly, in the patients classified as "Severely or moderately or suspiciously malnourished," the proportion of patients who underwent nutritional therapy was greater in group B than in group A (difference 21.0%; 95% CI 3.2% to 37.0%, $P = .0217$), with no significant differences regarding the type of nutritional therapy.

Relationship Between Sociodemographic and Clinical Characteristics and Patient's Nutritional Status

In the univariate analysis, the study variables significantly related to malnutrition were the location of the primary tumor ($P < .0001$), time with cancer treatment ($P = .0093$), and ECOG scale score ($P < .0001$). However, age, sex, employment status, and TNM stage did not show any relationship.

Factors associated with malnutrition in the univariate analysis at $P < .1$ were included in the multivariate analysis (Table 2). Results that are nonsignificant statistically but clinically interesting are based on family situation: It seems to indicate that eating alone may present a risk tendency to have malnutrition.

Pancreatic cancer, large intestine cancer, ECOG 1, and group assignment (group B) were significantly associated with malnutrition, according to the NUTRISCORE. Pancreatic cancer, ECOG 1 and 2, and group assignment (group B) were significantly associated with malnutrition according to the PG-SGA score.

No differences were found between the patient's symptoms and nutritional status according to NUTRISCORE, except pain. However, there was statistical significance for the PG-SGA results ($P < .05$). The patients who reported each problem (except in the case of dry mouth) were mostly in the group of patients severely or moderately malnourished.

Table 2
Multivariate Analysis of the 585 Patients Included in the Study to Evaluate the Potential Factors for Malnutrition

	NUTRISCORE ≥ 5		S/M/S-Malnourished*	
	OR (95% CI)	*P*	OR (95% CI)	*P*
PTL				
Ref: Lung				
Pancreas	11.84 (4.60-30.50)	<.0001	3.96 (1.82-8.64)	.0005
Large intestine	2.38 (1.38-4.08)	.0017	1.84 (0.92-3.67)	.0842
Other	0.78 (0.50-1.23)	.2844	1.72 (0.97-3.07)	.0655
Time with treatment				
Ref: <6 mo				
6-12 mo	0.82 (0.51-1.31)	.3990	0.77 (0.45-1.32)	.3408
≥12 mo	0.90 (0.52-1.53)	.6874	0.82 (0.43-1.56)	.5444
ECOG				
Ref: ECOG 0				
ECOG 1	1.72 (1.14-2.60)	.0101	3.39 (1.96-5.89)	<.0001
ECOG 2	1.71 (0.70-4.19)	.2401	11.30 (4.49-28.40)	<.0001
Study group				
Ref: Group A				
Group B	2.25 (1.47-3.46)	.0002	1.96 (1.20-3.22)	.0074

* According to the Patient-Generated Subjective Global Assessment (PG-SGA).
Group A, patients who underwent treatment with immunotherapy alone; group B, patients who underwent treatment with immunotherapy plus chemotherapy and/or radiotherapy.
Abbreviations: S/M/S, severely or moderately or suspiciously; PTL, primary tumor location; ECOG, Eastern Cooperative Oncology Group; Ref, Reference.

Discussion

The relationship between cancer and impaired nutritional status has been widely analyzed.[1-5] Malnutrition affects negatively not only clinical outcomes but also patient HR-QoL.[4,5,23] Furthermore, up to 80% of patients with advanced cancer will develop cachexia throughout their disease,[24,25] with the subsequent negative effect on function, treatment tolerance, and overall mortality.[23,26,27] Moreover, clinical data suggested that about 20% to 30% of deaths are attributable to malnutrition rather than to cancer.[23,27]

Due mainly to the improvement of cancer therapies, in many patients, although cancer is not curable, it has become a chronic disease. However, the clinical outcomes of these new cancer treatments might be hampered by the development of malnutrition and metabolic derangements, due not only to physical and metabolic effects of the cancer but also to anticancer therapies.[2-5]

In the current report, we evaluated the nutritional status of patients with cancer according to their cancer therapy in a real-world scenario. In addition, we have evaluated the proportion of patients who received any nutritional treatment and the relationship between the nutritional status and different socioeconomic, demographic, and clinical characteristics of the study population.

Our study found that malnutrition among cancer outpatients was 38.6% (according to the NUTRISCORE) and 20.5% (according to the PG-SGA). Interestingly, independent of the method used for assessing the nutritional status, the proportion of malnourished patients was significantly greater in group B than in group A, suggesting that immunotherapy has a lower impact on nutritional impairment.

Because the incidence of nutritional deficiencies and metabolic derangements among patients with cancer is high, it seems logical to evaluate the nutritional status of these patients and carry out an early therapeutic approach to these nutritional alterations to limit their deleterious effects. However, despite knowing that nutritional care can improve outcomes, its use is underevaluated in daily clinical practice.[28]

The results of our study confirm these findings, because only 97 (42.9%) and 59 (48.8%) of malnourished patients, according to

NUTRISCORE and PG-SGA, respectively, were receiving any kind of nutritional therapy.

From a clinical point of view, this fact is paradoxical because there is increasing evidence suggesting that a customized nutritional treatment reduces the risk of mortality and improves functional and HR-QoL outcomes in patients with cancer with increased nutritional risk.[3,4,27-30]

The nutritional treatment of weight-losing patients with cancer during active oncologic treatment comprises different types of strategies, including NA, ONS, EN, and PN. The choice depends on the patient's current situation: oncologic diagnosis, oncospecific treatment as optimized therapeutic strategy, prognosis, nutritional status, nutritional requirements, and duration of nutritional therapy.[3,4,29,30]

Among the 160 patients on nutritional therapy, 123 (76.9%) were on NA, 69 (43.1%) were taking ONS, 11 (6.9%) were taking EN, and 1 (0.6%) was taking PN.

Regardless of the nutritional screening tool, the NA was mainly prescribed by oncology nurses, whereas the other nutritional treatments (ONS, EN, and PN) were mainly prescribed by a nutritionist.

Finally, factors significantly associated with malnutrition (both NUTRISCORE and PG-SGA) in the univariate analysis were group assignment, primary tumor location, ECOG scale score, and time with cancer treatment. Factors significantly associated with malnutrition (both NUTRISCORE and PG-SGA) in the multivariate analysis were group assignment, pancreas cancer, and ECOG 1. Large intestine cancer was associated with malnutrition only in the NUTRISCORE, and ECOG 2, only in the PG-SGA score.

To the best of our knowledge, this is the first study evaluating the relationship between nutritional status and different socioeconomic, demographic, and clinical characteristics in outpatients with cancer.

In hospitalized patients with cancer, tumor location, social class, performance status, and age were significantly associated with malnutrition.[31,32] In agreement with those studies, we found that tumor location and performance status were significantly associated with malnutrition. However, our study did not find any relationship between malnutrition and age, sex, employment situation, family situation/number of family members, or TNM stage.

Although it is not easy to directly compare our results with those of the PreMiO study,[5] the rate of malnutrition seems to be somewhat lower in our study. Nevertheless, the prevalence of malnutrition (according to NUTRISCORE) was like that reported by Hébuterne et al.[11] As far as we know, there is not full agreement about the most accurate tools for screening/assessing nutritional status in patients with cancer. In our study, we used the PG-SGA, which has been considered as a specific nutritional assessment and screening tool for oncologic patients, and the NUTRISCORE, which was developed specifically for patients with cancer and validated by reference to the PG-SGA.[14,15] However, there is a good-quality meta-analysis published in recent years that indicates that a certain consensus begins to take place. Some nutritional screening tools have been at our disposal to assess the situation of patients with cancer. Fortunately, this is an advance that allows us to assess the patient more accurately and provide treatment tailored to their needs.[33,34]

This study has some limitations that should be considered when interpreting its results. The most important limitation is its retrospective designs. Selection bias and confounding are all inherent limitations of retrospective studies. Nevertheless, the strict inclusion/exclusion criteria applied in our study were such to minimize these potential biases. Additionally, this was a cross-sectional study, which is why it reflects a "still photo" of the situation of the patients with cancer at a specific moment but does not allow analysis of their evolution. Nevertheless, this multicenter study shows the current nutritional status and nutritional therapy, in a real-world scenario, of cancer outpatients in Spain.

Conclusion

Oncology nurses believe that one of our goals is to properly assess the nutritional status of outpatients with oncology who are undergoing treatment with immunotherapy, chemotherapy, or radiotherapy, thus improving the quality of life of our patients. The prevalence of malnutrition among patients with cancer was relatively high, with a greater rate of malnutrition in those patients who underwent treatment with chemotherapy. In addition, less than half of malnourished patients were receiving some type of nutritional therapy, which brings to the table the lack of awareness about the importance of alterations in nutritional status on the clinical outcomes and quality of life of patients with cancer. Finally, treatment strategy, treatment duration, performance status, and treatment location were independently associated with malnutrition. The key point for nurses is that we need to screen the patient for nutritional status to improve the quality of care provided.

It would have been interesting to identify the impact of the new cancer therapies on the nutritional status and on the effect of the nutritional treatment throughout the patient's follow-up. However, this will be the subject of future investigations, including qualitative approaches to assessing the nutritional status of our patients.

Members of the Spanish Society of Oncology Nursing Nutrition Group

Raquel Alvárez-García (Hospital Vall d'Hebrón, Barcelona, Spain), Sylvia Mónica Amoró-Cerdá (Son Espases University Hospital, Palma de Mallorca, Spain), Inmaculada Amoscotegui (Virgen del Rocío University Hospital, Sevilla, Spain), Magdalena Battle-Vidal (Son Espases University Hospital, Palma de Mallorca, Spain), Patricia Beorlegui-Murillo (Clínica Universitaria de Navarra, Navarra, Spain), Julio C. de la Torre-Montero (Universidad Pontificia Comillas, Madrid, and Fundación San Juan de Dios, Spain), María Camino Del Río-Pisabarro (Hospital Universitario Donosti, San Sebastián, Spain), Nuria Domenech Climent (Universidad de Alicante, Alicante, Spain), José Ángel García-Sáenz (Hospital Clínico San Carlos, Madrid, Spain), Carlos Garrido Caricol (12 de Octubre University Hospital, Madrid, Spain), Nieves Gil-Gómez (Hospital Universitario Quirón Pozuelo, Madrid, Spain), Iria González (Hospital Santa Creu i Sant Pau, Barcelona, Spain), Míriam González-Suárez (Hospital Universitario de Canarias, Palmas de Gran Canaria, Spain), Yohanna Iragorri Barberena (Clínica Universitaria de Navarra, Navarra, Spain), Pilar Matía Martín (Hospital Clínico San Carlos, Madrid, Spain), Erik Medina Cruz (Hospital Universitario de Canarias, Palmas de Gran Canaria, Spain), Ángeles Peñuelas (Hospital Vall d'Hebrón, Barcelona, Spain), Dolores Pérez-Cárdenas (12 de Octubre University Hospital, Madrid, Spain), Clara Pujol (Hospital Santa Creu i Sant Pau, Barcelona, Spain), Catalina Rubio Uría (Hospital Universitario de Canarias, Palmas de Gran Canaria, Spain), Adela Salieto-Tecles (Hospital Virgen de los Lirios, Alcoy, Spain), Andrés Sánchez-Belchiz (Virgen del Rocío University Hospital, Sevilla, Spain), Jorgina Serra-López (Hospital Santa Creu i Sant Pau, Barcelona, Spain), and Isabel Tuñón-Cabeza (12 de Octubre University Hospital, Madrid, Spain).

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Julio Cesar de la Torre-Montero reports financial support, administrative support, equipment, drugs, or supplies, statistical analysis, and writing assistance were provided by Comillas Pontifical University San Juan de Dios School of Nursing and Physiotherapy. Julio Cesar de la Torre-Montero reports a relationship with Comillas Pontifical University San Juan de Dios School of Nursing and Physiotherapy that includes: funding grants and non-financial support. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

CRediT authorship contribution statement

Julio C. de la Torre-Montero: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Jorgina Serra-López:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Raquel Alvárez-García:** Writing – review & editing, Writing – original draft, Project administration, Investigation. **Magdalena Battle-Vidal:** Writing – review & editing, Writing – original draft, Methodology, Investigation. **Nieves Gil-Gómez:** Writing – review & editing, Writing – original draft, Validation, Supervision, Resources, Project administration, Investigation, Funding acquisition, Conceptualization. **Patricia Beorlegui-Murillo:** Writing – review & editing, Writing – original draft, Validation, Resources, Project administration, Methodology, Investigation, Funding acquisition, Conceptualization. **Dolores Pérez-Cárdenas:** Writing – review & editing, Writing – original draft, Resources, Methodology, Investigation. **Andrés Sánchez-Belchiz:** Writing – review & editing, Writing – original draft, Investigation. **Erik Medina Cruz:** Writing – review & editing, Writing – original draft, Methodology. **Ángeles Peñuelas-Saiz:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition.

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Institutional Review Board Statement

The study was conducted according to the guidelines of the Declaration of Helsinki and approved by the local ethics committee of the 12 de Octubre Hospital, Madrid, Spain. Informed consent was obtained from all subjects involved in the study.

Availability of Materials and Data

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

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References

1. Planas M, Álvarez-Hernández J, León-Sanz M, Celaya-Pérez S, Araujo K, García de Lorenzo A, PREDyCES® Researchers. Prevalence of hospital malnutrition in cancer patients: a sub-analysis of the PREDyCES® study. *Support Care Cancer*. 2016;24(1):429–435.
2. de Las Peñas R, Majem M, Perez-Altozano J, et al. SEOM clinical guidelines on nutrition in cancer patients (2018). *Clin Transl Oncol*. 2019;21(1):87–93.
3. Arends J, Bachmann P, Baracos V, et al. ESPEN guidelines on nutrition in cancer patients. *Clin Nutr*. 2017;36(1):11–48.
4. Virizuela JA, Camblor-Álvarez M, Luengo-Pérez LM, et al. Nutritional support and parenteral nutrition in cancer patients: an expert consensus report. *Clin Transl Oncol*. 2018;20(5):619–629.
5. Muscaritoli M, Lucia S, Farcomeni A, PreMiO Study Group. Prevalence of malnutrition in patients at first medical oncology visit: the PreMiO study. *Oncotarget*. 2017;8(45):79884–79896.
6. Stanculeanu DL, Daniela Z, Lazescu A, Bunghez R, Anghel R. Development of new immunotherapy treatments in different cancer types. *J Med Life*. 2016;9(3):240–248.
7. Seidel JA, Otsuka A, Kabashima K. Anti-PD-1 and anti-CTLA-4 therapies in cancer: mechanisms of action. *efficacy, and limitations*. Front Oncol.. 2018;8:86.
8. Michot JM, Bigenwald C, Champiat S, et al. Immune-related adverse events with immune checkpoint blockade: a comprehensive review. *Eur J Cancer*. 2016;54:139–148.
9. Ramos-Casals M, Brahmer JR, Callahan MK, et al. Immune-related adverse events of checkpoint inhibitors. *Nat Rev Dis Primers*. 2020;6(1):38.
10. Soldati L, Di Renzo L, Jirillo E, Ascierto PA, Marincola FM, De Lorenzo A. The influence of diet on anti-cancer immune responsiveness. *J Transl Med*. 2018;16(1):75.
11. Hébuterne X, Lemarié E, Michallet M, de Montreuil CB, Schneider SM, Goldwasser F. Prevalence of malnutrition and current use of nutrition support in patients with cancer. *JPEN J Parenter Enteral Nutr*. 2014;38(2):196–204.
12. Gheorghe C, Pascu O, Iacob R, et al. Nutritional risk screening and prevalence of malnutrition on admission to gastroenterology departments: a multicentric study. *Chirurgia (Bucur)*. 2013;108(4):535–541.
13. Segura A, Pardo J, Jara C, et al. An epidemiological evaluation of the prevalence of malnutrition in Spanish patients with locally advanced or metastatic cancer. *Clin Nutr*. 2005;24(5):801–814.
14. Arribas HL, Sendrós MJ, Peiró I, Salleras N, Fort E. NUTRISCORE: a new nutritional screening tool for oncological outpatients. *Nutrition*. 2017;33:297–303.
15. Gómez-Candela C, Cos AI, Martínez-Roque V, Iglesias C, Zamora P, González-Barón R. Valoración global subjetiva en el paciente neoplásico. *Nutr Hosp*. 2003;6:353–357.
16. Brierley JD, Gospodarowicz MK, Wittekind C, eds. *TNM Classification of Malignant Tumours*. 8th ed. Chichester: John Wiley and Sons; 2017.
17. Shiravand Y, Khodadadi F, Kashani SMA, et al. Immune checkpoint inhibitors in cancer therapy. *Curr Oncol*. 2022;29(5):3044–3060.
18. 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 Cancer J Clin*. 2021;71(3):209–249.
19. American Psychiatric Associattion. 2021 DSM-5 Diagnoses and New ICD-10-CM Codes. Available in: https://www.psychiatry.org/psychiatrists/practice/dsm/updates-to-dsm/coding-updates/2021-coding-updates Last accessed April 24, 2023.
20. Mischel AM, Rosielle DA. Eastern Cooperative Oncology Group Performance Status #434. *J Palliat Med*. 2022;25(3):508–510.
21. Red Española de Registros de Cáncer. Estimaciones de la incidencia del cáncer en España, 2019. Available in: https://redecan.org/en/projects/4/estimates-of-the-incidence-of-cancer-in-spain-2019 Last accessed April 24, 2023.
22. Las cifras del cáncer en España 2020. Available in: https://seom.org/seomcms/images/stories/recursos/Cifras_del_cancer_2020.pdf Last accessed November 27, 2024.
23. Kasvis P, Vigano M, Vigano A. Health-related quality of life across cancer cachexia stages. *Ann Palliat Med*. 2019;8(1):33–42.
24. Fearon KC, Glass DJ, Guttridge DC. Cancer cachexia: mediators, signaling, and metabolic pathways. *Cell Metab*. 2012;16(2):153–166.
25. Porporato PE. Understanding cachexia as a cancer metabolism syndrome. *Oncogenesis*. 2016;5(2):e200.
26. Melstrom LG, Melstrom Jr KA, Ding XZ, Adrian TE. Mechanisms of skeletal muscle degradation and its therapy in cancer cachexia. *Histol Histopathol*. 2007;22(7):805–814.
27. Cotogni P, Stragliotto S, Ossola M, Collo A, Riso S. on behalf of the Intersociety Italian Working Group for Nutritional Support in Cancer. The role of nutritional support for cancer patients in palliative care. *Nutrients*. 2021;13(2):306.
28. Bargetzi L, Brack C, Herrmann J, et al. Nutritional support during the hospital stay reduces mortality in patients with different types of cancers: secondary analysis of a prospective randomized trial. *Ann Oncol*. 2021;32(8):1025–1033.
29. Arends J, Strasser F, Gonella S, ESMO Guidelines Committee. Cancer cachexia in adult patients: ESMO Clinical Practice Guidelines. *ESMO Open*. 2021;6(3):100092.
30. Caccialanza R, Cotogni P, Cereda E, et al. Nutritional Support in Cancer patients: update of the Italian Intersociety Working Group practical recommendations. *J Cancer*. 2022;13(9):2705–2716.
31. Wie GA, Cho YA, Kim SY, Kim SM, Bae JM, Joung H. Prevalence and risk factors of malnutrition among cancer patients according to tumor location and stage in the National Cancer Center in Korea. *Nutrition*. 2010;26(3):263–268.
32. Silva FR, de Oliveira MG, Souza AS, Figueroa JN, Santos CS. Factors associated with malnutrition in hospitalized cancer patients: a cross-sectional study. *Nutr J*. 2015;14:123.
33. Cortés-Aguilar R, Malih N, Abbate M, Fresneda S, Yañez A, Bennasar-Veny M. Validity of nutrition screening tools for risk of malnutrition among hospitalized adult patients: a systematic review and meta-analysis. *Clin Nutr*. 2024;43(5):1094–1116.
34. Cheung HHT, Joynt GM, Lee A. Diagnostic test accuracy of preoperative nutritional screening tools in adults for malnutrition: a systematic review and network meta-analysis. *Int J Surg*. 2024;110(2):1090–1098.