Original Article

Nutrition assessment and its relationship with performance and Glasgow prognostic scores in Vietnamese patients with esophageal cancer

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Background and Objectives: To determine the nutritional status of patients with esophageal cancer, and to investigate its relationship with performance status and prognosis. **Methods and Study Design:** This clinical, cross-sectional study was conducted from August 2014 to February 2015 at National Cancer Hospital, Hanoi, Vietnam. Stage III/IV esophageal cancer patients were assessed for their nutritional status (patient-generated subjective global assessment (PG-SGA) and SGA scores, BMI, mid-arm circumference (MAC), energy and protein intakes, weight changes, Karnofsky and Eastern cooperative oncology group performance scores (KPS/ECOG), and Glasgow prognostic score (GPS). **Results:** Sixty-four male patients were enrolled. The mean ± standard deviation of PG-SGA score was 9.88±4.41. SGA revealed 44% as class B and 6.2% as class C. The BMI revealed 43.8% of patients were underweight. MAC measurement revealed 29.7% of undernourished patients. Patients with an energy intake <25 kcal/kg/d comprised 54.7%, and 48.4% with <1 g/kg/day of protein. Totally, 68.8%, 84.4% and 92.2% patients exhibited weight loss past 2-weeks, one-month and six-months, respectively. The PG-SGA and SGA strongly correlated with the KPS (r=-0.717 and 0.632, both p<0.001) and ECOG (r=0.672 and 0.626, both p<0.001), but were weakly correlated with the GPS (r=0.332 and 0.278, p<0.01 and 0.05). The KPS, ECOG, BMI, MAC, energy and protein intakes, and weight change were not correlated with the GPS. **Conclusions:** Malnutrition, weight change, and insufficient intake were noteworthy in esophageal cancer patients. The PG-SGA and SGA were strongly correlated with the performance status, but weakly correlated with prognostic indices.

Key Words: esophageal cancer, nutritional status, performance score, prognostic score, weight loss

INTRODUCTION

Esophageal cancer is the eighth most common type of cancer worldwide. Most incidence and mortality cases of esophageal cancer (83% and 86% respectively) are found in developing countries.[1] In Vietnam, the overall age-adjusted mortality rate associated with esophageal cancer in males and females was 2.3 and 0.8 of 100,000 in 2008.[2] The ratios of the disease indices during 2006-2007 and 1993-1998 (2.34: 1 in males and 1.43:1 in females) imply that the disease is spreading rapidly.[3]

Most of esophageal cancer patients are at stage III/IV at the time of hospital admission.[4] Malnutrition and weight loss are common concerns in 80% of patients.[5-7] All cancer patients should be screened for malnutrition and those at the risk should be referred for further assessment to receive an appropriate nutrition support plan.[8,9]

A performance status is defined as an assessment of an actual function and the capability of self-care of a patient.[10] The assessment of a functional status includes physical performance measures, which have been recommended as a part of nutrition assessment for decades.[11]

Among several metrics developed for quantifying the performance status, the Eastern Cooperative Oncology Group (ECOG) performance score, and Karnofsky performance score (KPS) are typically used in cancer research.[10]

In clinical practice, prognostic tools help health care staff make clinical decisions. Complex indices are less frequently used or ineffective in the assessment. A preferred alternative is a single prognostic index, or perhaps a tool with a few indices.[12] Over the past decades, the Glasgow Prognostic score (GPS), based on serum alb-

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umin and C reactive protein (CRP) levels, has been considered the most extensively validated tool, and is thus used in routine clinical assessment for cancer patients.[13] Moreover, it has been considered the basis for a nutrition-based management in cancer patients.[14]

The ESPEN guidelines of 2014 on nutrition for cancer recommended the necessity of objective and quantitative assessments for nutritional intake, physical performance, and systemic inflammation in patients with an abnormal screening.[15] This study was conducted to determine the nutrition status of patients with stage III/IV esophageal cancer by using subjective global assessment (SGA), patient-generated SGA(PG-SGA), anthropometric measurements (weight, height, BMI, mid-arm circumference), energy and protein intakes, and to examine the relationship between nutrition status and performance scores such as the KPS, ECOG performance score, and GPS.

METHODS

Patients and study design

This clinical, cross-sectional study enrolled patients registered at or admitted to National Cancer Hospital (NCH) with a diagnosis of esophageal cancer from August 2014 to February 2015. The NCH is a national oncology hospital located in Hanoi, and receives referral cases from the surrounding Northern provinces of Vietnam. In addition, the NCH is an educational institutional affiliated with Hanoi Medical University. In Vietnam, most stage III/IV esophageal cancer patients receive chemo-radio therapy. Therefore, after hospital admission, the patients are usually referred to the radiotherapy ward for the simultaneous admission of radiotherapy and chemotherapy. For this study, the patients were screened within 48 hours after admission at the Radiotherapy ward. This study recruited male patients aged 18 to 65 years who were diagnosed with stage III/IV esophageal cancer[16] according to the TNM (Tumor, Nodes, and Metastases) classification of malignant tumors,[17] based on histological analysis Squamous cell carcinoma (SCC) or Adenocarcinoma (AD), no sooner than 3 days post-operation for percutaneous endoscopic gastrostomy, and who could read and write adequately. Those with a history of tumour treatment (chemotherapy, radiotherapy or surgery), and recurrent esophageal cancer, a history or presence of other diseases that might affect the nutritional status, such as gastrointestinal diseases, chronic liver diseases, kidney diseases, heart failure, total or partial paralyzed before the diagnosis of esophageal cancer, and a systemic inflammatory response, such as sepsis symptoms, lung diseases, and trauma were excluded.

The study was approved by the Human Research Ethics Committee of the National Cancer Hospital of Vietnam (No.247/BVK-HDDD), conforming to the provisions of the Declaration of Helsinki in 1995, as revised in Edinburgh in 2000. All patients participated voluntarily and signed the informed consent form.

Data collection

Within 48h after patient admission to the radiotherapy ward, patients were screened for the study inclusion criteria. The enrolled patients were asked to sign informed consent form for participating in the study, and to fill in the first part of PG-SGA form (the rest to be completed by a physician) to obtain general information. On the following early morning, the blood sample of all recruited patients was collected in addition to other information including anthropometric measures, and 24-hour dietary records. The SGA, PG-SGA, KPS, and ECOG performance scores were assessed by a researcher.

Anthropometric measurements

Body weight was measured using an electronic weighing scale (LAICA S.P.A., Italy) with a precision of 100 g, early in the morning, after urinating, and defecation. Body height was recorded using a stadiometer, composed of wooden boards with a precision of 1 mm. Body mass index (BMI) was calculated as on weight in kilogram divided by height in meters squared (kg/m^2). The patients were classified as underweight, normal weight, overweight, and obese according to the World health organization (WHO) criteria.[18,19]

Table 1. World Health Organization (WHO) body weight classification criteria

Classification	Principle cut-off points	Cut-off points for the Asian population
Underweight	BMI<18.5	BMI<18.5
Normal weight	18.5≤BMI≤24.99	18.5≤BMI≤22.99
Overweight	BMI≥25	23≤BMI≤24.99
Obese	BMI≥30	BMI≥25

Mid-arm circumference

Measurement tapes were used to measure the left mid-upper arm circumference in centimetres with a precision of 1 mm. For MAC, cut-off points of 22 cm and 23 cm were used for women and men, respectively.[20]

24-hour dietary recall

Dietary intakes were measured by a dietitian. This included administering a 24-hour dietary recall, using food portion size models with images to help patients imagine and understand the estimation. Both oral and tube feeding were noted. Parenteral nutrition was calculated according to information from medical records. Results of the sum of the 24-hour dietary recall and total parenteral nutrition (if available) were calculated as kilocalorie energy and gram protein intake within 24-hour by using the software of Vietnam National Institute of Nutrition based on local food composition and the nutritional content from parenteral nutrition commercial products. Cut-off points for energy intake were >35 kcal/kg/d, 30-35 kcal/kg/d, 25-30 kcal/kg/d, and <25 kcal/kg/d while thresholds of protein intake were >2 g/kg/d, 1.2-2 g/kg/d, 1-1.2 g/kg/d, and <1 g/kg/d, based on ESPEN guidelines.[9,15]

Patient- generated subjective global assessment score

PG-SGA scores were assessed for all patients. This tool comprised 2 sections that were completed by a patient or a clinician accordingly. Four medical components, namely weight loss, nutrition impact symptoms, intakes,

and functional capacity were assessed in a check box format, which completed by the patient. Later, the physician scored the disease status and its relation with nutritional requirements, metabolic demands, and physical examinations. PG-SGA scores were classified as introduced in the form. A higher score reflected a higher risk of malnutrition. Moreover, an appropriate action plan was recommended. A score 0-1 indicated that the patient did not require an intervention. A score of 2-3 score suggested patients and their family needed nutrition education and counselling by a medical staff (e.g., a dietitian, a nurse or a physician) and/or a pharmacologic intervention, as indicated. A score of 4-8 score meant the patient required intervention by dietitians in collaboration with nurses or physicians. A score ≥9 score indicated a critical need for improved symptom management and/or nutrient intervention options.[21]

Subjective global assessment score

The SGA scores were assessed by a dietitian and included 2 major components: 1) a history of weight loss, changes in dietary intake, GI symptoms, functional capacity, and metabolic demand associated with the underlying disease and 2) a physical examination focusing on the detection of muscle wasting, a loss of subcutaneous fat and the presence of edema. The nutritional status of a patient was classified as (A) well-nourished, (B) moderately (or suspected of being) malnourished, and (C) severely malnourished.[22]

Weight change

Weight change was defined as a change in total weight divided by the number of months (1 month or 6 months). Weight change was positive if a patient gained the weight, and negative if the patient lost it.

Karnofsky performance score

The KPS ranged from 100% (no complaint with no evidence of any disease) to 0% (death) and was divided into 3 sub-classes, as follows: Level A=80%-100% (patients were able to perform normal activities and work); Level B=50%-70% (patients were unable to work), and Level C ≤50% (patients were unable to carry themselves).[23]

Eastern cooperative oncology group-performance score

The 5-point ECOG[24] performance score ranged from 0 to 5. Patients who scored 0 were fully active and able to perform all the pre-disease performances without restriction. At score 1, they exhibited restricted physically strenuous activity but were able to perform sedentary-type activities. Score 2 indicated ambulatory situations and patients capable of all self-care but unable to perform any work-related activities, with ≥50% of waking hours. Score 3 indicated patients capable of limited self-care, confined to a bed or chair, with ≥50% of waking hours. Patients who scored 4 were completely disabled, and those who scored 5 were deceased.

Glasgow prognostic score

The GPS was calculated on the basis of the serum albumin and CRP levels. Blood samples (5 mL) were collected from a peripheral vein with a single puncture early in the morning (6:00 AM to 7:00 AM), following the standardized procedures of the Clinical Analysis Laboratory at NCH. Serum albumin and CRP levels were measured using an automated biochemical analyzer (Olympus AU400 Chemistry Analyzer Tokyo, Japan) with other chemical substances being measured with another instrument (Beckman Coulter Ireland Inc 250s, Lismeehan). The GPS ranged between 0 and 2 as follows: Score 0 (CRP ≥10 mg/L and albumin ≥35 g/L), score 1 (CRP >10 mg/L or albumin <35 g/L), and score 2 (CRP >10 mg/L and albumin <35 g/L). Figure 1 illustrates the study objectives.

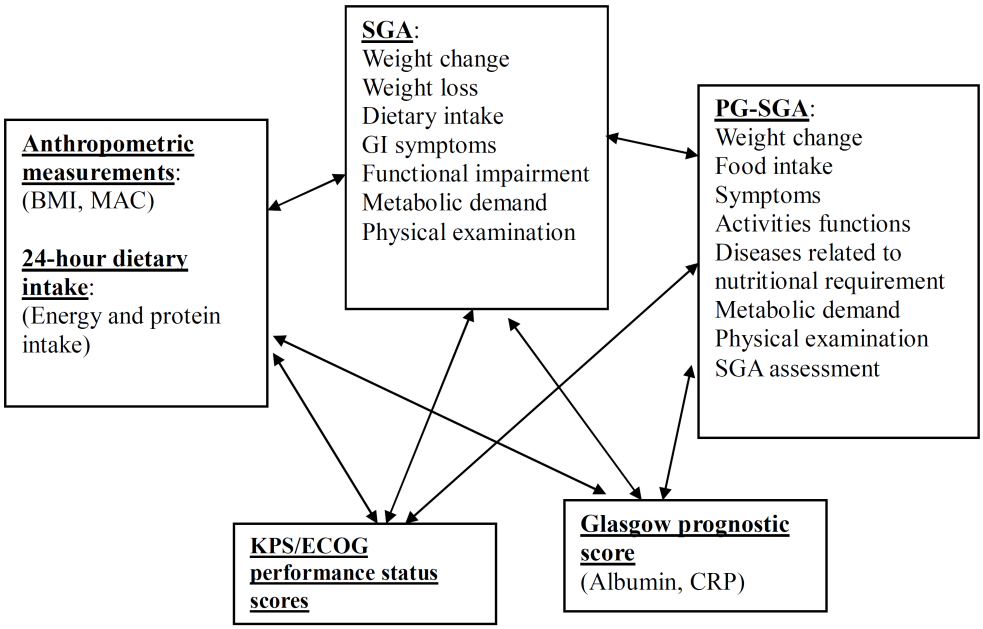

Figure 1. Study objective, which described the hypothesis of this study. The study hypothesis was anthropometric measurements, SGA, PG-SGA, performance status scores and Glasgow prognostic score correlated with each other.

Table 2. Patient demographics

Characteristics	N (%)	Mean±SD (range)	Median
Age (years)		54.9±6.52 (35-64)	57
Tumor location in the esophagus			
1/3 upper	9 (14.1)		
1/3 middle	47 (73.4)		
1/3 lower	8 (12.5)		
Stage of the esophageal cancer disease			
Stage III	31 (48.4)		
Stage IV	33 (51.6)		
Pathology diagnosis: SCC	64 (100)		
Number of patients had placed PEG	40 (62.5)		
Number of days post placed PEG		8.6±18.0 (3-114)	4

SCC: Squamous cell carcinoma; PEG: Percutaneous endoscopic gastrostomy.

Statistical considerations

Epidata (Version 3.1) software was used to develop datasets on demographics, anthropometrics, SGA and PG-SGA scores, biochemical analysis, KPS, ECOG performance score, and GPS. Data on 24-hour dietary intake were analyzed using the dietary analysis software of the Vietnam National Institute of Nutrition, based on Vietnamese food composition. All input data were statistical analyzed using the Statistical Package for the Social Sciences (SPSS, version 16.0) for Windows. Continuous variables were presented as the mean ± standard deviation (SD); whereas categorical variables were presented as the number and percentage values (N%). The correlation coefficient between 2 variables was assessed using the Pearson's product-moment correlation coefficient for data with normal distribution, and Spearman's rho test was conducted for those with non-normal distribution.

RESULTS

General characteristics

Demographic data

Of 266 patients admitted between August 2014 and February 2015, this study selected 64 male patients diagnosed with SCC. Two female patients were excluded for failing to meet the inclusion criteria. The mean±SD of age was 54.9±6.5 years (median=57 years and range=35-64 years). The middle of the esophagus was the most common tumour location (73.4%), followed by the upper (14.1%) and the lower esophagus (12.5%). Thirty-one patients (48.4%) were at stage III of the disease, and 33 patients (51.6%) were at stage IV. Forty patients received percutaneous endoscopic gastrostomy (PEG). The mean±SD of post-PEG days was 8.6±18.0 (median=4 days and range=3-114 days) (Table 2).

Characteristics of nutritional assessment

Table 3 listed the anthropometric measurements of the patients. The BMI values identified approximately half of the study population (43.8%) as underweight, and 1 patient (1.6%) as overweight. MAC measurements based on the cut-off point for men suggested that 29.7% of patients were at the risk of undernutrition.

The energy intake was 24.5±11.2 kcal/kg/d (median was 23.8 kcal/kg/d and range=6.1-73.0 kcal/kg/d), and protein intake was 1.1±0.5 g/kg/day (median was 1 g/kg/day and range=0.3-3.1 g/kg/day). According to the ESPEN recommendations, more than half of the patients (54.7%) had an energy intake <25 kcal/kg/day, and approximately half of the study population (48.4%) had a protein intake <1 g/kg/day (Table 3).

The mean±SD of the PG-SGA scores was 9.88±4.41 (median=9). Based on the PG-SGA assessment, all patients required a nutritional intervention at various levels. The majority of the patients (54.7%) were in critical need of a nutrition intervention (PG-SGA score ≥9). The SGA scores implied 43.8% of patients at moderate malnutrition and 6.2% at severe malnutrition (Table 3).

Mean weight±SD at hospital admission was 49.7±9.4 kg. The mean weight changes ± SD in the last one and six months were -2.8±3.1 kg and -5.0±3.7 kg, respectively. Among those who exhibited weight loss, the mean±SD of weight loss in the last one and six months were -3.6±2.7 kg (median=-3.2 kg) and -5.4±3.5 kg (median=-5.0 kg), respectively. Most patients typically lost their weight (68.8%) in the last two weeks before admission, except for 2 patients (3.1%) who gained weight. The proportions of patients who experienced weight change under 5%, 5% to 10%, and above 10% were relatively similar (31.2%, 35.9%, and 32.8% respectively) (Table 3).

Characteristics of performance scores and prognostic scores

The mean±SD of the KPS in the study patients was 77.5±15.1 (median=80) whereas the mean ± SD of ECOG scores was 1.47±0.67 (median=1). These scores reflected the ability of a patient to perform daily activities on their own. Almost patients exhibited a GPS equal to 0 and 1 (52.5% and 42.6%, respectively) (Table 3).

Correlation among nutritional measurements, performance scores, and prognostic scores

Correlation of SGA and PG-SGA scores with anthropometric measurements and dietary intake

The BMI values had a weak negative correlation with the PG-SGA (r=-0.266, p<0.05) and no correlation with the SGA. Both SGA and PG-SGA were negatively correlated with the MAC index (r=-0.304, p<0.05 and r=-0.414, p<0.01, respectively). Both the SGA and PG-SGA were moderately correlated with energy intake (kcal/kg/d) and protein intake (g/kg/day) (r=-0.4, p<0.01) (Table 4).

Table 3. Characteristics on anthropometric measurements, dietary intake, SGA and PG-SGA assessment, weight change, performance scores and GPS

Characteristics	N (%)	Mean±SD (range)	Median
Anthropometric measurements			
Weight (kg)		49.8±6.8 (37.1-73.5)	48.8
Height (cm)		163±6.3 (143-175)	163
BMI (kg/m^2)†		19.9±2.1 (14.9-25.6)	18.9
≤18.5	28 (43.8)		
18.5-22.99	34 (53.1)		
23-24.99	1 (1.6)		
25-27.49	1 (1.6)		
MAC (mm)		24.0±2.4 (18.8-32.3)	24.1
Undernutrition	19 (29.7)		
Normal	45 (70.3)		
Dietary intake assessment			
Energy intake (kcal/d)		1208±552 (364-3883)	1,116
Energy intake (kcal/kg/d)		24.5±11.2 (6.1-73)	23.8
Under 25	35 (54.7)		
25-30	13 (20.3)		
30-35	8 (12.5)		
Over 35	8 (12.5)		
Protein intake (g/d)		53.2±25.1 (14.4-155)	47.2
Protein intake (g/kg/d) classification		1.1±0.5 (0.3-3.1)	1.0
Under 1	31 (48.4)		
1-1.2	11 (17.2)		
1.2-1.5	10 (15.6)		
1.5-2	10 (15.6)		
Over 2	2 (3.1)		
SGA and PG-SGA			
PG-SGA score		9.88±4.41 (2-21)	
2-3	3 (4.7)		
4-8	26 (40.6)		
≥9	35 (54.7)		
SGA classification			
A	32 (50)		
B	28 (43.8)		
C	4 (6.2)		
Weight change			
Weight change past two weeks			
Weight loss	44 (68.8)		
Weight stable	18 (28.1).		
Weight gain	2 (3.1)		
Weight change past one month (kg)		-2.8±3.1 (-12.9-2.7)	-2.4
Weight loss past one month (kg)	54 (84.4)	-3.6 (-12.9--0.2)	-3.2
Weight change past six months (kg)		-5.0±3.7 (-19.4-1.8)	-4.7
Weight loss past six months (kg)	59 (93.7)	-5.4 (-19.4--0.2)	-5.0
Percent weight change past six months			
Under 5%	20 (31.2)		
From 5% to 10%	23 (35.9)		
Above 10%	21 (32.8)		
Performance scores and GPS			
KPS score		77.5±13.1 (50-90)	80
ECOG score		1.47±0.67 (0-3)	1
GPS score			
0	32 (52.5)		
1	26 (42.6)		
2	3 (4.9)		

MAC: Mid arm circumference; PG-SGA: patient- generated subjective global assessment; SGA: subjective global assessment; KPS: Karnofsky performance score; ECOG: Eastern cooperative oncology group-performance score; GPS: Glasgow Prognostic score.
†Body mass index, calculated by Weight (in kg)/(Height (in meters))^2.

Correlation of SGA and PG-SGA scores with performance scores, GPS, and weight change

The SGA and PG-SGA scores were strongly correlated with the KPS and ECOG. Both the SGA and PG-SGA were negatively correlated with the KPS (r=-0.632 and r=-0.717, both p<0.001). The SGA and PG-SGA were positively correlated with ECOG (r=0.626 and r=0.672, both p<0.001). Both SGA and PG-SGA were weakly correlated with GPS (r=0.278, p<0.05 and r=0.332, p<0.01, respectively). The SGA and PG-SGA were negatively correlated with the weight change. The SGA was not found to have a significant correlation with the weight change past one month; however, it was moderately correlated with the weight change past six months (r=-0.429,

$p<0.001$). The PG-SGA revealed a correlation with the weight change past one and six months ($r=-0.318$, $p<0.05$ and $r=0.405$, $p<0.01$, respectively) (Table 4).

Correlation of anthropometric measurements and dietary intake with performance scores and GPS

Anthropometric measurements, namely BMI and MAC, did not have a significant correlation with the GPS. Their correlations with performance scores were weak. The strongest correlation was reported between MAC and KPS ($r=0.391$, $p<0.01$).

Dietary intake was not found to be correlated with the GPS. Its correlation with performance scores was weak, with r value ranging from 0.318 ($p<0.05$) to 0.396 ($p<0.01$) (Table 4).

Correlation of performance scores with anthropometric measurements, dietary intake, and GPS

Performance scores were not correlated with the GPS. The correlation of performance scores with anthropometric measurements was weak, with the highest r value being similar to the correlation between the KPS and MAC ($r=0.391$, $p<0.05$). The correlation of performance scores with energy intake (kcal/kg/d) and protein intake (g/kg/d) was similar with r value, ranging from 0.318 ($p<0.05$) to 0.396 ($p<0.01$) (Table 3).

Correlation between weight change and performance scores, GPS, dietary intake

The weight change past one month was not correlated with either performance scores or the GPS. In addition, the GPS was not correlated with the weight change past six months. The correlations between the weight changes in the past six months and performance scores were weak, with $r=0.278$ ($p<0.05$) for the KPS and $r=-0.352$ ($p<0.01$) for the ECOG.

The weight change past one month correlated with the energy and protein intakes ($r=0.307$, $p<0.05$, and $r=0.377$, $p<0.01$, respectively). The weight change past six months was correlated with energy intake ($r=0.299$, $p<0.05$), but was not correlated with protein intake (Table 4).

The summary of correlations among nutritional assessments, performance status scores, and Glasgow prognostic scores is shown in Figures 2a and 2b.

DISCUSSION

Most of the study patients were 50-60 years old, and all of them had SCC. The mean ± SD of PG-SGA scores was 9.88±4.41, implying that the patients required a nutrition intervention. The energy and protein intakes of most of the patients were well below the minimum recommended level. Almost all of them experienced weight loss. Both PG-SGA and SGA were strongly correlated with performance scores, but weakly correlated with the GPS. None of the indicators (KPS, ECOG, BMI, MAC, energy and protein intakes, and the weight change past one and six months) were correlated with the GPS.

General characteristics

The mean age of the study population was 54.9±6.5 (range=35-64 years). This was consistent with the results of previous studies, as conducted in Iran,[25] Germany,[26] Taiwan,[27] and China. [28]

All study patients were diagnosed with SCC. This result was inconsistent with those of the previous studies conducted in Germany (50.7%),[26] and Iran (86.9%).[29] Our results may reflect the trend of SCC in Asian countries, as demonstrated in Taiwan's report.[30] Further research is warranted to determine whether Vietnam belongs to the "Asian esophageal cancer belt", where 90% of cases concern SCC.[31] The most common tumour location was detection in the middle one-third of the esophagus (73.4%). This result was inconsistent with that reported by Gholipour et al, who discovered that only 32.9% of cases exhibit the tumour at the centre of the esophagus.[29] This difference could be due to the inclusion criteria requiring the tumour location to be entirely at the esophagus. Some patients were excluded because tumours were located in the upper or lower one-third spread-out of the esophagus.

During the study period, 2 female patients with esophageal cancer were excluded because one was >65 years old and the other exhibited an esophageal tumour metastasized from throat cancer. Therefore, further epidemiological research on esophageal tumour located entirely in the esophagus in women is recommended.

Characteristics of nutritional assessments

The PG-SGA revealed that 95.3% of the studied patients required a nutrition intervention (PG-SGA score ≥4) whereas the SGA indicated this proportion to be at 50% (SGA classes B and C). The BMI values revealed that 43.8% of patients were underweight. MAC measurements identified 29.7% study patients as undernourished. These results implied that the PG-SGA identified the largest number of patients requiring nutrition intervention. This finding was consistent with those of previous studies in patients with gynecologic cancer,[32] lung cancer,[33] head and neck cancer.[34] This probably because the PG-SGA is the most specific nutritional assessment tool for hospitalized cancer patients.[21,35]

Most of our study population exhibited a decrease in energy and protein intake compared with the minimum levels mandated by the ESPEN guidelines,[9,15] even after they received PEG as a feeding support. Certain studies have reported that a decrease in these patients is due to the physical dysfunction of the esophagus.[36,37] However, a low nutrient intake in patients with PEG requires further investigation to determine the causes and cures of these problems.

Weight loss is a common symptom in patients with advanced cancer.[38] In our study, more than two-thirds of patients (69%) exhibited weight loss within 2 weeks before of hospital admission. The mean±SD of the weight change past one month was -2.8±3.1 kg (median=-2.4 kg), and 84.4% patients exhibited weight loss (median=-3.2 kg). The mean±SD of the weight loss past six months was -5.0±3.7 kg (median=-3.2 kg), and 93.7% patients exhibited weight loss. This might be due to difficulty swallowing because of the tumour, reported in 84.4% of patients (data not shown).

Table 4. Correlation between anthropometric measurements, dietary intake, SGA and PG-SGA assessment, weight change, performance scores and GPS

		Anthropometric		Dietary intake		Performance scores			Weight change	
		BMI	MAC	Energy intake (kcal/kg/d)	Protein intake (g/kg/d)	KPS	ECOG	GPS	Weight change past one month	Weight change past six months
SGA	*r*	-0.105	-0.304*	-0.448**	-0.414**	-0.632**	0.626**	0.278*	-0.123	-0.429**
	p	0.41	0.015	<0.001	0.001	<0.001	<0.001	0.03	0.334	<0.001
PG-SGA	*r*	-0.266*	-0.414**	-0.468**	-0.444**	-0.717**	0.672**	0.332**	-0.318*	-0.405**
	p	0.03	0.001	<0.001	<0.001	<0.001	<0.001	0.009	0.01	0.001
Anthropometric										
BMI	*r*					0.254*	-0.145	0.085		
	p					0.042	0.253	0.514		
MAC	*r*					0.391**	-0.273*	-0.247		
	p					0.001	0.029	0.055		
Dietary intake										
Energy intake (kcal/kg/d)	*r*					0.375**	-0.396**	-0.159		
	p					0.002	0.001	0.221		
Protein intake (g/kg/day)	*r*					0.318*	-0.348**	-0.197		
	p					0.011	0.005	0.127		
Performance scores										
KPS	*r*	0.254*	0.391*	0.375**	0.318*			-0.224		
	p	0.042	0.001	0.002	0.011			0.083		
ECOG	*r*	0.145	-0.273*	-0.396**	-0.348**			0.219		
	p	0.253	0.029	0.001	0.005			0.09		
Weight change										
Weight change past one month	*r*			0.307*	0.377**	0.138	-0.211	0.105		
	p			0.013	0.002	0.276	0.094	0.422		
Weight change past six months	*r*			0.299*	0.242	0.278*	-0.352**	-0.143		
	p			0.017	0.056	0.027	0.005	0.275		

*Correlation is significant at the 0.05 level (2-tailed).
**Correlation is significant at the 0.01 level (2-tailed).

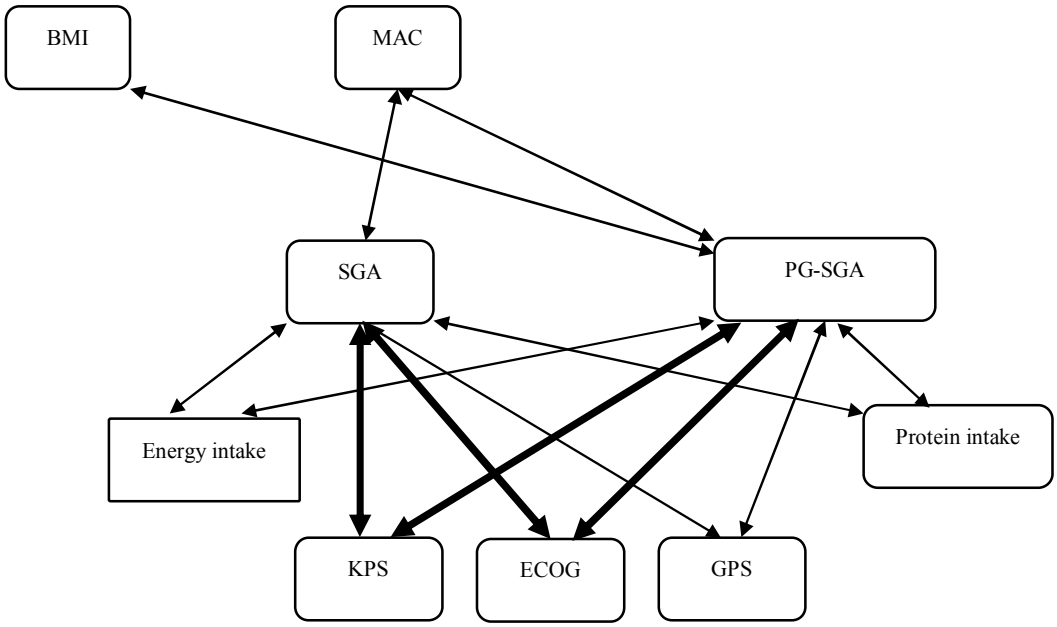

Figure 2a. Correlation of SGA and PG-SGA assessments with anthropometric measurements, dietary intake, performance status scores and GPS.

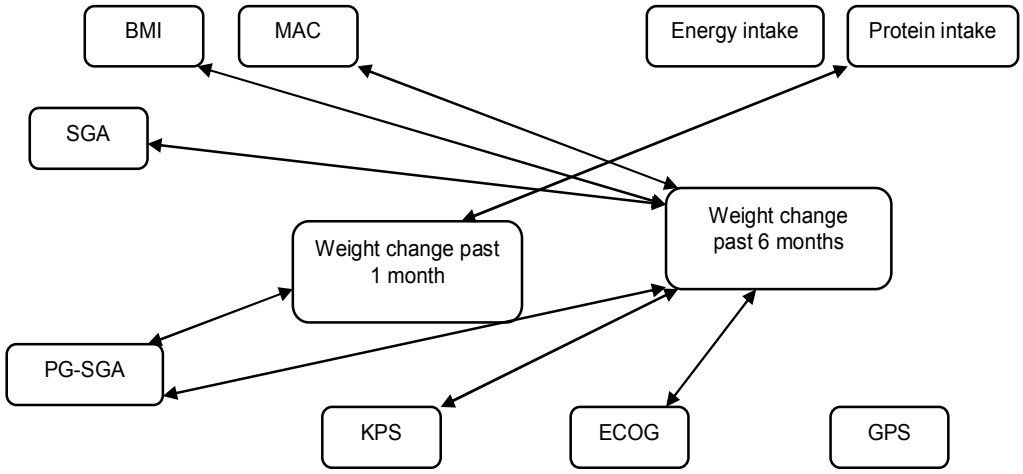

Figure 2b. Correlation of weight change with nutrition assessments, performance status scores and GPS.

Relationship of nutritional status with performance scores and Glasgow prognostic score

In our study, the results of nutritional assessments at hospital admission (SGA, PG-SGA, BMI, MAC, energy and protein intake) were significantly correlated with performance scores, but weakly correlated with GPS; the performance scores at hospital admission was not correlated with the GPS. These findings are consistent with those reported in previous studies. Stanley reported that the KPS was 1 of the 3 most crucial prognostic factors affecting survival among 77 prognostic factors in patients with operable bronchogenic carcinoma of the lungs.[39] Chang reported ECOG to be an essential predictor of survival in patients with advanced hepatocarcinoma.[40] Sitthinamsuwan reported that an ECOG performance score >1 was a significant prognostic factor indicating a poor survival outcomes in patients for the treatment of primary central nervous system lymphoma.[41] Skipworth reported that KPS was correlated with the CRP.[42] Gomes de Lima claimed that the nutritional status was associated with inflammation markers and prognosis tools in patients with GI cancer.[43] Mauricio reported an association between nutritional status and the GPS.[44] Therefore, the present study investigated the correlation among 3 components (the nutritional status, performance status and prognostic index) in male patients at advanced stages of esophageal cancer. Moreover, our results implied that several other factors may affect the prognosis of patient treatment outcomes; hence, a regular nutrition assessment and adequate nutrition intervention throughout the treatment period may improve the prognosis of the treatment outcomes of patients.

Weight change was weakly correlated with dietary intake in our study. This result was consistent with those in previous studies.[45-47] The weight change in cancer population can be explained by various mechanisms, such as anorexia and abnormal metabolic adaptations to starvation[46], which are not due solely to reduced food intake.[47]

Conclusion

A malnutrition status with weight loss and an insufficient dietary intake were the most critical concerns in patients

with stage III/IV esophageal cancer. The association between nutritional status and performance scores was strong whereas the association between nutritional status and GPS was weak. Weight change was not correlated with the GPS; nevertheless, the weight change in the past six months was weakly correlated with performance scores.

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AUTHOR DISCLOSURES

All authors have no conflict of interest regarding this paper. This is an original article with no prior publication.

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