Original article

The relationship between PG-SGA scores and nutritional status of patients receiving chemotherapy

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Abstract. *Background:* Cancer patients are at risk of malnutrition even before diagnosis. Herein, we aimed to determine the nutritional education status of cancer patients; define the malnutrition rate with the PG-SGA evaluation method; determine the use of oral nutritional support; and to evaluate the relationship between these parameters. *Materials/Methods:* PG-SGA malnutrition assessment tool and questionnaire about nutrition education status and oral nutritional support were carried out among 281 cancer patients treated in the chemotherapy unit of a private health institution. *Results:* We found that 56.1% of the patients received their nutritional information from the doctors. There was not a significant relationship between nutritional education status and malnutrition. According to the PG-SGA evaluation, 37.7% of the patients were moderately malnourished and 6.8% were severely malnourished. However, it is seen that 72.5% of malnourished patients do not receive oral nutritional support. The PG-SGA results revealed that albumin was significantly lower in patients with severe malnutrition compared to other groups. It was found that malnutrition was overlooked in 82% of patients when evaluated with BMI alone. *Conclusion:* PG-SGA is a tool that should be used routinely among chemotherapy patients. The validity of the PG-SGA short form should be conducted as it may provide ease of application and widespread use.

Key words: PG-SGA, Nutrition Education, Cancer, Malnutrition

Introduction

Cancer is an important public health problem that is the second leading cause of death in the world and in our country (1). Cancer patients are at risk of malnutrition even before diagnosis (2). The prevalence of malnutrition is higher in cancer patients than in other disease groups, and the risk increases with age (3).

The presence of malnutrition is associated with decreased treatment efficacy, decline in functional status, quality of life, and survival. However, preventing or treating malnutrition not only reduces the patient's morbidity and increases life expectancy, but also provides significant economic savings by preventing unnecessary treatment (4,5).

The guideline created by ASPEN (The American Society for Parenteral and Enteral Nutrition) for the nutritional therapy of cancer patients emphasizes that nutritional screening should be performed using formal nutritional assessment methods to identify patients who are at nutritional risk and need a care plan (6). According to ESPEN's (European Society for Clinical Nutrition and Metabolism) guideline, nutritional status should be evaluated frequently in cancer patients and the nutrition plan should be updated according to the changes in circumstances (7).

The methods and procedures used in determining the nutritional status are as diet history and detection of food intake, medical history, psychosocial

data, biochemical and functional tests and anthropometric measurements (3,7)

PG-SGA (Patient-Generated Subjective Global Assessment), a new form of SGA developed for cancer patients, is an assessment method that provides the opportunity to identify the symptoms related to disease and treatment. It is recommended to by ASPEN be used in the evaluation of cancer patients (6). Screening for nutrition risk aims to increase awareness of malnutrition, as well as the probability of early diagnosis and treatment (8).

As a nutritional assessment method used in the diagnosis of malnutrition, PG-SGA has 98% accuracy in the evaluation of the nutritional status of cancer patients. This nutritional assessment tool is a comprehensive assessment tool that includes criteria for weight change, change in food intake, presence of nutrition-related symptoms, physical and functional capacity, as well as physical examination, steroid use, and presence of fever (7, 9-11). Early detection of malnourished patients and providing appropriate nutritional support improves their nutritional status and quality of life (12). ESPEN and Australia, Europe, England and the United States guidelines recommend oral nutritional fluid/solution during treatment to increase oral intake of malnourished cancer patients (6,7,13). In this study, we aimed to determine the nutritional education status of cancer patients; define the malnutrition rate with the PG-SGA evaluation method; determine the use of oral nutritional support (ONS); and to evaluate the relationship between these parameters.

Materials and methods

Cancer patients who were treated in the outpatient chemotherapy unit of Acıbadem Altunizade Hospital were included in the study. A questionnaire (Appendix 1) was applied to the patients, which investigated the nutritional education and the use of ONS. Nutritional status was evaluated using the PG-SGA nutrition assessment tool. Albumin levels reported in the last 15 days were obtained retrospectively from the biochemistry results of patients. The weight and height of the patients were obtained from the patient charts on the assessment day. The questionnaire and PG-SGA were applied by a dietician with a face-to-face interview. The questionnaire study was administered while the patients were receiving chemotherapy in the chemotherapy unit.

In the PG-SGA assessment, the patient's nutritional assessment score is obtained by summing the scores obtained from each question box. PG-SGA-A indicates that the patient is well-nourished or anabolic. PG-SGA-B means suspected malnutrition whereas PG-SGA-C is used to express severe malnutrition (11). Recommendations on nutritional intervention according to the final score are also part of this assessment. The recommendations according to this classification based on scoring are as follows:

PG-SGA score of 0-1; No intervention is required at this time. The patient should be routinely and frequently reassessed during treatment.

PG-SGA score of 2-3; The patient and her family should be educated by a dietitian, nurse or clinician. He should undergo pharmacological interventions which are determined in accordance with the symptomatic research and biochemical results of the patient.

Patients with a PG-SGA score of 4-9; The patients require the intervention of a dietitian in collaboration with a nurse or physician.

Patients with a PG-SGA score >9; The patients are in a serious need for improved symptom management and/or nutrient fulfillment options.

Ethical aspects

Ethical approval for this study was obtained from the Acıbadem Mehmet Ali Aydınlar Universty Medical Research review board (ATADEK) -protocol 2022-08/15. Patients participated voluntarily and provided written informed consent.

In the statistical analysis of the data, mean (x), standard deviation (SD), minimum and maximum statistics were used for numerical variables, whereas count (n) and percentage (%) statistics were used for categorical variables. Group comparisons were conducted with independent samples t-test for two independent groups, and analysis of variance (ANOVA) for more than two independent groups. Statistical analyses were

performed using SPSS (version 25) and MedCalc (version 15.8) software. The significance level was accepted as 0.05.

Results

281 cancer patients treated in the chemotherapy outpatient unit were included in the study. 39.5% of the patients had breast cancer, 16.4% had lung cancer, 14.9% had colon cancer, and 11% had gastrointestinal system cancer. 61.6% of the patients were female and 38.5% were male. The mean age of the patients was 57.54±13.09.

It was found that 46.6% of the participants received nutritional information after the diagnosis. It was reported that the source of nutritional information were doctors for 56.1% of the patients. The source was dietitians for 14.9% of the patients, internet for 10.9%, nurses for 6.6%, and other sources (friends, print media, visual media) for 11.7%. While 96.7% of the patients reported that they did not use alternative treatment, 29.6% of the patients reported that they used vitamin and mineral supplements. Only 4.98% of the patients had PG-SGA scores in the range of 0-1, while 25.97% of patients had a score in the range of 2-3. 40.92% scored between 4 and 9 whereas 28.11% had over 9 points. According to the global assessment categories of PG-SGA, 55.5% of the patients were well-nourished (SGA-A), 37.7% had moderate and suspected malnutrition (SGA-B), and 6.8% had severe malnutrition (SGA-C) (Table 1).

A statistically significant difference was found in SGA-A scores of breast cancer and gastrointestinal system cancer group ($p<0.05$). There was a statistically significant difference between breast and lung cancer patients in terms of SGA-C category ($p<0.05$).

When the groups that received and did not receive nutrition education were compared in terms of the results of the nutritional evaluation, there was not any significant difference between any categories (Table 2).

There was no statistically significant relationship between the use of vitamin and mineral supplements on the PG-SGA score and Global assessment scores of the patients.

Table 1. Characteristics of the participants

	n (%)
Age, years, mean (SD)	57.54 (13.09)
Gender	
Female	173 (61.5)
Male	108 (38.5)
Diagnosis	
Breast cancer	111 (39.5)
Lung cancer	46 (16.4)
Colon cancer	42 (14.9)
Gastric cancer	31 (11.0)
Head and neck cancer	8 (2.8)
Central nervous system cancer	6 (2.1)
Prostate cancer	6 (2.1)
Gynecologic cancers	19 (6.8)
Others	19 (6.8)
Nutrition Education	
Yes	127 (46.6)
No	154 (53.4)
Trainer of Nutrition Education	
Doctor	222 (56.1)
Dietitian	59 (14.9)
Nurse	26 (6.6)
Internet	43 (10.9)
Other (friends, printed media, visual media)	46 (11.5)
SGA classification	
SGA-A	156 (55.5)
SGA-B	106 (37.7)
SGA-C	19 (6.8)
PG-SGA score	
0-1	14 (4.9)
2-3	73 (26.0)
4-9	115 (40.9)
>9	79 (28.2)
Use of Alternative Treatment	
Yes	9 (3.2)
No	261 (92.9)
Prefers Not to Answer	11 (3.9)
Use of Vitamin-Mineral Supplementation	
Yes	82 (29.2)
No	195 (69.4)
Prefers Not to Answer	4 (1.4)

PG-SGA: Patient-Generated Subjective Global Assessment.

When the ONS usage status was compared according to PG-SGA categories, the difference between the ONS users and non-users was significant in the SGA-A category (32.7% and 60.5%, respectively) and in the SGA-B category (55.1% and %34.1, respectively). The difference between ONS and

Table 2. Nutrition education with respect to SGA categories and PG-SGA score

		With nutrition education; n(%)	Without nutrition education; n(%)
SGA category			
	A	65 (51.2)	91 (59.1)
	B	50 (39.4)	56 (36.4)
	C	12 (9.4)	7 (4.5)
PG-SGA score			
	0-1	3 (2.4)	11 (7.1)
	2-3	31 (24.4)	42 (27.3)
	4-9	56 (44.1)	59 (38.3)
	>9	37 (29.1)	42 (27.3)

PG-SGA: Patient-Generated Subjective Global Assessment.

Table 3. Use of Oral Nutritional Supplementation (ONS) with respect to SGA categories and PG-SGA score

		ONS user; n(%)	Do not use ONS n(%)
SGA category			
	A	16 (32.7)	133 (60.5)
	B	27 (55.1)	75 (34.1)
	C	6 (12.2)	12 (5.5)
PG-SGA score			
	0-1	1 (2.0)	11 (5.0)
	2-3	4 (8.2)	67 (30.5)
	4-9	20 (40.8)	91 (41.4)
	>9	24 (49)	51 (23.2)

PG-SGA: Patient-Generated Subjective Global Assessment.

non-users is statistically non-significant in the SGA-C category (12.2% and 5.5%, respectively). When the users and the non-users of ONS were compared separately according to the score ranges of the PG-SGA assessment, the ratios of those in the 2–3-point category (8.2% and 30.5%, respectively) and the rates of >9 points category (49.0% and %23.2, respectively) were found to be statistically significant, while the differences between other categories were not statistically significant (Table 3).

The difference between malnourished and non-malnourished patients according to age and BMI category were compared separately for the Global PG-SGA categories. While the differences for the SGA-A (58.9% and 31.3%, respectively) and SGA-B categories (35.1% and 56.3%, respectively) were statistically significant, the difference in the SGA-C category (12.5% and 6.0%, respectively) was not statistically significant. We compared malnourished and non-malnourished patients as informed by age and BMI, for each score range of the PG-SGA results. The difference in the 0-1 score category was not significant due to insufficient data. There was a statistically significant difference in the score range of 2-3 (28.2% and 9.4%, respectively) and >9 (23.8% and 59.4%, respectively). However, the difference in the range of 4-9 (42.3% and 31%, respectively) is not statistically significant.

In the evaluation of malnutrition according to the age group and BMI results versus the SGA score, there was not a statistically significant difference between the two evaluation methods, except

Table 4. Comparison of malnutrition assessment according to age groups and BMI

		BMI*; n(%)	BMI**; n(%)
SGA category			
	A	10 (31.3)	146 (58.9)
	B	18 (56.3)	87 (35.1)
	C	4 (12.5)	15 (6.0)
PG-SGA score			
	0-1	0 (0)	14 (5.6)
	2-3	3 (9.4)	70 (28.2)
	4-9	10 (31.3)	105 (42.3)
	>9	19 (59.4)	59 (23.8)

PG-SGA: Patient-Generated Subjective Global Assessment; BMI: Body Mass Index; *BMI <20 for <70y old and <22 for >70y old; **BMI >20 for <70y old and >22 for >70y old.

for patients with severe malnutrition (p<0.05) (Table 4).

Albumin levels of 20.9% of the patients were reached. While the mean albumin value of the patients who were in the category of PG-SGA-C were 2.7±0.48 g/dl, the mean albumin value of the patients in the PG-SGA-A group was 3.39±0.49 g/dl. while it is 3.19±0.64 g/dl.

PG-SGA-B group.

The difference between the PG-SGA global evaluation groups and the mean albumin levels was statistically significant (F=5.176 and p=0.009). Pairwise comparisons showed that the difference between the mean albumin levels of the SGA-A and SGA-C groups was statistically significant, while the average albumin of the SGA-B group was not statistically different from the average of the other two groups.

When the score ranges of the PG-SGA were entered as a factor, the difference between the mean albumin values was statistically significant (F=6.193 and p=0.001). According to the results of the pairwise comparisons, there was not a statistically significant difference between the groups that received 0-1, 2-3 and 4-9 points. The mean of the severely malnourished group who got 9 points or more was found to be statistically lower than the means of the other groups. (Table 5).

Table 5. PG-SGA scores and average albumin levels

	N	Mean (SD)	P
SGA category			
	A	3.396 (0.4903)	
	B	3.196 (0.6428)	***0.009***
	C	2.711 (0.4833)	
PG-SGA score			
	0-1	3.800 (0.2646)	
	2-3	3.443 (0.4433)	***0.001***
	4-9	3.379 (0.5798)	
	>9	2.861 (0.5433)	

PG-SGA: Patient-Generated Subjective Global Assessment.

Discussion

The results of this study showed that patients received nutritional information mostly from the doctors (56.1%), and when we compared the malnutrition categories and the status of education, there was no difference between the groups who received education and those who did not. This shows that nutrition education and evaluation is a separate discipline and as emphasized in the latest ESPEN guideline, the dietitian should be a part of the cancer treatment team. ESPEN recommends assessment of nutritional status with validated tools. Nutritional evaluation should be conducted for cancer patients at diagnosis, and nutrition education and follow-up should be planned according to the results of the evaluation. Guidelines emphasize the need for frequent re-evaluation of nutritional status in cancer patients. Cancer treatment is dynamic, and the type and severity of side effects on nutrition also vary as the treatment progresses or with protocol changes. In modern oncology, evaluation and monitoring of the patient's nutritional status, in addition to treatment, is regarded as a distinguishing feature of good clinical practice. (9-11,13)

Recent studies demonstrated that malnutrition can be associated with reduced treatment effectiveness, functional status, quality of life, and survival (16). In nutritional assessment of cancer patients, unintentional weight loss is an important component that is often the first visible sign of the disease among these patients, with 40% of the patients reporting that they

had lost more than 10% of their usual body weight when first diagnosed (17).

The PG-SGA was derived from the SGA for the oncology population and Oncology Nutrition Dietetic Practice Group of the American Dietetic Association mentioned PG-SGA as gold standard for oncology (18,19).In ambulatory oncology settings, PG-SGA has been validated and as a highly sensitive and specific assessment tool it is broadly used in other care settings and also is used to validate the other screening methods (20,21).The PG-SGA closely correlates with patient weight loss in the previous 6 months, length of hospital stay, and quality of life (20,22).

In this context, many studies emphasized the importance of screening the nutritional status of cancer patients receiving outpatient treatment. In one of the first studies on this subject, 1453 cancer patients receiving outpatient treatment were screened (6). It was reported that 32% of the patients were under nutritional risk. In another similar study, nutritional status and information needs were evaluated. According to the results depending on PG-SGA scores, 49% of patients were malnourished. The authors report that 46% of patients with malnutrition needed symptom control and/or nutritional intervention (23).

In a multicenter, observational cohort study the prevalence of malnutrition in elderly patients with cancer, PG-SFA SF was used to assess nutritional status and 31.5% of patients were found to be undernourished compared to PG-SGA SF.Results of multivariate analysis have been reported to be associated with malnutrition (PG-SGA SF > 5), worse OS (over-all survival) (HR: 1.47.95%CI:1.29-1.68), affecting quality of life, and more frequent symptoms of nutritional influence. PG-SGA SF and PG-SGA have been reported to perform similarly, but better than GLIM, for predicting mortality. It has been reported that PG-SGA SF can improve the predictive ability of the TNM classification system for mortality in elderly patients with cancer, including distinguishing between patients' prognoses and guiding immune-therapy. The authors recommended evaluation of nutritional status with PG-SGA SF, which is a prognostic factor for OS and may improve the prognostic model of TNM in elderly cancer patients (24).

In our study we used PG-SGA as an assessment tool. In this study 37.7% of the patients were evaluated as moderately malnourished (SGA-B), and 6.8% as severely malnourished (SGA-C). Due to the high socioeconomic level of patients in our study, we estimate that access to food is not an issue for our study population. We think that the nutritional barriers caused by the disease and the treatment as well as the nutritional assessment made by evaluating only weight change and BMI may lead to mistakes in referring patients with malnutrition to the diet polyclinic for nutrition education. We think that the fact that the study is conducted in a private hospital may cause patients and their relatives to hesitate about referring to a dietitian, due to the fact that diet polyclinic services require additional payment.

When the BMI categories according to age and the PG-SGA results were compared, we found that the malnutrition status of 82% of the patients in the SGA-B and SGA-C categories would be overlooked if they were evaluated with BMI alone. Accordingly, PG-SGA or other nutritional assessment tools (NRS-2002, MUST, etc.) should be used to minimize the possibility of error when evaluating the nutritional status of cancer patients. We concluded that while there is no problem in identifying severe malnutrition based on age and BMI, moderate or suspected malnutrition can be overlooked.

Malignant and stromal immune cells in cancer patients cause chronic inflammation and finally leading to complex catabolic sequelae (25). There is an extensive and reliable association between systemic inflammation and poor clinical outcome in cancer patients. A widely validated and simple score to categorize systemic inflammation is the modified Glasgow Prognostic Score, based on C-reactive protein and serum albumin (C-reactive protein normal: 0; raised C-reactive protein and normal albumin: 1; raised C-reactive protein and low albumin: 2). This score is highly prognostic of clinical outcome (26).

Albumin is a biochemical parameter that is frequently used in the evaluation of nutritional status (13). According to our findings, the difference between the PG-SGA global evaluation score and the albumin results was statistically significant. In the pairwise comparisons, only the difference between the mean

albumin levels of the well-nourished and severely malnourished groups was statistically significant. PG-SGA results are valuable for centers that have difficulty in carrying out biochemical tests or evaluate biochemical parameters less frequently due to economic reasons. The fact that albumin replacement and C-reactive protein values were not investigated within the scope of this study can be considered as limitation.

According to the ESMO nutritional guidelines, nutritional intervention should be considered in patients receiving anticancer therapy and/or in those with an expected survival of more than a few (i.e. 3-6) months. Energy and nutrient intake should be monitored, and cancer patients who are undernourished should receive nutritional support as an essential component of the best supportive care to improve food intake, body weight and quality of life. In patients able to eat, nutritional support should be based on dietary counselling, guidance on choosing high-energy, high-protein foods, enriching foods (e.g. by adding fat/oils, protein powder) and use of oral nutritional supplements but if oral support is not sufficient and lower GI tract is working, tube feeding should be offered, otherwise PN is the best way to support nutritional needs. Different ways of feeding may be combined for the best result. In latest guidelines of ESPEN, implementation of nutritional support, including dietary advice, oral nutritional supplements, and enteral and parenteral nutrition, as an effective way to improve nutrition is recommended to prevent malnutrition in patients. However, when choosing the nutritional support method, it is stated that if oral nutrition is insufficient despite nutritional interventions, enteral nutrition should be recommended, and if enteral nutrition is not sufficient or practicable, parenteral nutrition should be recommended (27,28).

We found that only 27.5% of the patients with SGA-B or SGA-C malnutrition status received ONS support, while 72.5% did not receive ONS support. While there was no difference between patients receiving and not receiving ONS in the SGA-C category, the difference between the groups in the SGA-B category indicates that patients with moderate/suspected malnutrition is more often overlooked in the clinical evaluation. Identifying the need for nutritional intervention with valid screening tools constitutes the first step towards nutritional supplementation, and these screening programs should be placed among the routine practices of oncology centers.

The statements of the patients regarding the use of vitamin-mineral supplementation and alternative treatment are inconsistent with the literature. In this evaluation, which was conducted during outpatient treatment, we think that the patients might have hesitated to express their behavior on this subject. In a phase III study on vitamin-mineral supplementation during breast cancer and chemotherapy process conducted between 2003 and 2010, 48% of the patients were reported to take multivitamins, 20% take vitamin C, 15% take vitamin vit E and 10% take folic acid, and 34% use calcium supplementation (29). In another study, it was reported that 30-90% of cancer patients used antioxidants or micronutrients to improve their immune system without the advice of their doctors (30).

In this study, all patients treated in the chemotherapy unit (regardless of the stage of the disease and the duration of diagnosis) were included in the study. This is the limitation of our study.

As a conclisions; In the outpatient unit, patients stay in the hospital for longer treatment periods. In this context, regular nutritional evaluation with PG-SGA and reinforcing nutrition education with regular repetitions may provide an opportunity to reduce the risk of malnutrition and to treat malnutrition. In our country, the number of oncology dietitians who provide regular service in outpatient units is extremely limited. With the use of these assessment tools, patients who need nutrition education and planning can be quickly referred to oncology diet outpatient clinics.

Conflict of Interest: Each author declares that he or she has no commercial associations (e.g., consultancies, stock ownership, equity interest, patent/licensing arrangement etc.) that might pose a conflict of interest in connection with the submitted article.

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