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ORIGINAL ARTICLE

Malnutrition as a predictor of prolonged length of hospital stay in patients with gynecologic malignancy: A comparative analysis*

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Abstract

Objective To explore the consistency of the Patient-generated Subjective Global Assessment (PG-SGA) and Nutritional Risk Screening-2002 (NRS-2002) for nutritional evaluation of patients with gynecologic malignancy and their predictive effect on the length of hospital stay (LOS).

Methods We recruited 147 hospitalized patients with gynecologic malignancy from Nanfang Hospital in 2017. Their nutritional status was assessed using the PG-SGA and NRS-2002. The consistency between the two assessments was compared via the Kappa test. The relationship between malnutrition and LOS was analyzed using crosstabs and Spearman's correlation.

Results The PG-SGA demonstrated that 66.7% and 54.4% of patients scoring ≥ 2 and ≥ 4 were malnourished, respectively. Furthermore, the NRS-2002 indicated that 55.8% of patients were at nutritional risk. Patients with ovarian cancer had a relatively high incidence of malnutrition. However, this was only significant for patients who scored ≥ 4 in the PG-SGA (P = 0.001 and P = 0.019 for endometrial carcinoma and cervical cancer, respectively). The PG-SGA and NRS-2002 showed good consistency in evaluating the nutritional status of patients with gynecologic malignancy (0.689, 0.643 for PG-SGA score ≥ 2, score ≥ 4 and NRS-2002, respectively). Both the scores of PG-SGA and NRS-2002 were positively correlated with LOS. Furthermore, prolonged LOS was higher in patients with malnutrition than in those with adequate nutrition.

Conclusion The PG-SGA and NRS-2002 shared a good consistency in evaluating the nutritional status of patients with gynecologic malignancy. Both assessments could be used as predictors of LOS.

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Key words: malnutrition; patient-generated subjective global assessment; nutritional risk screening-2002; length of hospital stay; gynecologic malignancy

Malnutrition in hospitalized patients is a crucial issue and has been related to higher rates of morbidity and mortality [1]. Several studies have reported that the prevalence of malnutrition among those with cancer ranges from 31%-97% [2–3]. The association between malnutrition and hospitalization has been established for some diseases, in particular, malignant diseases [4]. Hence, it is important to identify malnourished patients. Knowing the patient's nutritional status may help improve patient outcomes during hospitalization. The assessment of nutritional status may be directed to several nutrition features as further discussed below.

The Patient-generated Subjective Global Assessment (PG-SGA) is a further modification of the SGA. The PG-SGA was developed specifically for cancer patients with a number of different conditions, and adapted by Ottery [5] for cancer patients. The PG-SGA as a patient's nutritional assessment has been used in various cancers, including colorectal cancer [6], head and neck cancer [7], esophageal cancer, and gynecological cancer [8]. It provides a numerical score, which translates as the level of nutrition intervention required. A higher score

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indicates a greater risk for malnutrition. Rodrigues *et al* [9]. showed that the PG-SGA could be used as a major predictor of prognosis and mortality in patients with gynecologic cancer. The Nutritional Risk Screening-2002 (NRS-2002) is a simple process for triaging at-risk patients indicated for nutrition interventions by assessing body mass index, appetite, weight loss, and severity of the disease. The NRS-2002 has been reported to effectively predict the nutritional risk for gynecologic patients. According to these studies, malnourished patients as determined by the NRS-2002, showed a significantly higher complication rate and longer LOS [4]. Malnutrition identified by the PG-SGA and NRS-2002 may reflect the patient prognosis and has been frequently used as an outcome measure [10]. Hence, the PG-SGA and NRS-2002 are useful for detecting the nutritional status of patients with cancer [11–12]. Additionally, the PG-SGA and NRS-2002 are considered the best validated tools for oncology patients [13]. However, studies have consistently shown the inadequacy of any single assessment tool in accurately determining a patient's nutritional status [14]. Therefore, we used the PG-SGA and NRS-2002 in combination for assessing patients with gynecologic malignancy. The assessment tools were applied before patients showed any signs of malnutrition and nutritional risk. To our knowledge, no study has yet evaluated the nutritional status of patients with gynecologic malignancy using both PG-SGA and NRS-2002.

The length of hospital stay (LOS) is used as the surrogate marker of a patient's recovery [15] and as an indicator of resource consumption [16]. Predicting LOS helps to minimize costs and maximize hospital resources [17] and facilitates an effective health care plan [15]. Guaitoli *et al* [15]. have shown that malnutrition as evaluated by the PG-SGA and the risk of malnutrition as evaluated by NRS-2002 are associated with a prolonged LOS.

The study aimed to evaluate the consistency of the PG-SGA and NRS-2002 in the nutritional evaluation of patients with gynecologic malignancy. The study also investigated if nutritional status as assessed by both can predict LOS.

Materials and methods

Participants and setting

All patients were recruited from Nanfang Hospital, Southern Medical University. The inclusion criterion was patients with histologically verified malignant gynecologic tumors. The exclusion criteria included patients who did not sign informed consent, patients who declined nutritional assessment, and patients younger than 18 years of age. From January 2017 to December 2017, 147 patients met the inclusion criteria. Patients were categorized according to their cancer sites: (1) cervical cancer (88 cases); (2) endometrial carcinoma (26 cases), and 3) ovarian cancer (33 cases).

Instruments

PG-SGA

The PG-SGA was used as previously reported to assess nutritional status 5, based on features of the physical examination and patient history. It consists of two sections including (1) a questionnaire about recent weight loss, food intake, and symptoms (such as nausea, diarrhea, and vomiting), and (2) information about the patient's disease and metabolic needs. Based on the global rating, those with a score < 2 were classified as well-nourished; a score between 2 and 4 as moderately malnourished or suspected of being malnourished; and ≥ 4 as severely malnourished 5. For analysis, each patient was classified as well-nourished (score < 2) or malnourished (score ≥ 2) 5. We also identified those with a malnutrition score of ≥ 4 to distinguish the patients who were in critical need of nutritional intervention [18].

NRS-2002

The NRS-2002 evaluates recent unintentional weight loss, appetite, and disease severity, and was recommended by the European Society of Parenteral and Enteral Nutrition as a preferred method of nutritional risk screening in hospital patients [19]. The final NRS-2002 score was between 0 and 7, and a score of ≥ 3 was classified as having nutritional risk [19]. The NRS-2002 examiners were not aware of the experimental test results at the time of the assessment.

Prolonged LOS

To explore whether the PG-SGA and NRS-2002 scores could predict the LOS of patients with gynecologic malignancy, prolonged LOS was defined as more than the median hospitalization day20, and the patients were divided into two categories, surgery and chemotherapy patients.

Data collection

By the time the patients were admitted to the hospital, our researchers had already obtained basic information from the nurses' station. Within 48 h after admission, we described the purpose of our study to potential patients and recruited those who were willing to participate in the study and provide informed consent. Subsequently, the investigators were trained by a nutritional specialist from our hospital and informed of relevant precautions when completing the PG-SGA and NRS-2002. Furthermore, whether the patients underwent surgery or chemotherapy, and their LOS, were determined after discharge from the hospital.

Statistical analysis

Measurement data were expressed as medians (*P25*, *P75*) and analyzed using the Mann-Whitney *U* test. The Kappa test was used to analyze the consistency of nutritional assessment via the PG-SGA and NRS-2002. Additionally, the receiver operator curve was plotted on the basis of the ability of the PG-SGA to evaluate the diagnostic value of NRS-2002. Crosstabs and Spearman's correlation were used to evaluate the relationship between malnutrition and LOS. Statistical analysis was performed using the SPSS statistics version 20.0 (IBM Corp., Armonk, NY). $P < 0.05$ was considered statistically significant.

Results

Patient characteristics

In our retrospective analysis, the patient's age, previous anti-tumor treatment, type of tumor, treatment methods, and the most recent LOS of the 147 recruited patients are shown in Tables 1–3.

Nutritional status assessed by the PG-SGA and NRS-2002

The PG-SGA median score was 4 (1, 7), and the NRS-2002 score was 3 (1, 3 Based on the PG-SGA); 98 patients (66.7%) scored ≥ 2, and 80 patients (54.4%) scored ≥ 4. In the NRS-2002 assessment, 82 patients (55.8%) scored ≥ 3 (Table 2).

The incidence of malnutrition in patients with cervical cancer, endometrial carcinoma, ovarian cancer, and other cancers such as gynecologic malignancy was assessed using the PG-SGA and NRS-2002 scores (Table 2). The results showed that patients with ovarian cancer have a relatively high incidence of malnutrition (78.8%, PG-SGA ≥ 2; 75.8%, PG-SGA ≥ 4; 69.7%, NRS-2002 ≥ 3). In contrast, patients with endometrial have the lowest incidence of malnutrition (53.8%, PG-SGA ≥ 2; 34.6%, PG-SGA ≥ 4; 42.3%, NRS-2002 ≥ 3). Only the incidence of malnutrition (PG-SGA≥ 4) was significantly different between patients with ovarian cancer and those with endometrial carcinoma or cervical cancer ($P = 0.001$ and $P = 0.019$, respectively).

Consistency between the PG-SGA and NRS-2002

The Kappa test was used to assess the consistency of the two instruments for assessing malnutrition. When the PG-SGA score ≥2 was set as the standard for a diagnosis of malnutrition, we found that the positive rate of PG-SGA was significantly consistent with the NRS-2002 for all patients ($k = 0.689$) and patients with cervical cancer ($k = 0.626$), endometrial carcinoma ($k = 0.772$), or ovarian

Table 1 Basic clinical characteristics of patients

Item				
Previous anti-tumor treatment	Untreated (*n* = 52)	Neoadjuvant treatment (*n* = 30)	Surgery (*n* = 20)	Postoperative chemotherapy (*n* = 45)
Treatment received in our hospital	Chemotherapy patients (*n* = 82)		Surgical Patients (*n* = 65)	
Length of hospital stay (days)	4 (3, 6)		10 (9, 13)	
Age (years)	47.5 (41.75, 55)		48 (40.5, 54.5)	

Table 2 The incidence of malnutrition in gynecologic malignant patients according to the score of PG-SGA and NRS-2002 [*n* (%)]

Reference method		Total patients (*n* = 147)	Cervical cancer patients (*n* = 88)	Endometrial carcinoma patients (*n* = 26)	Ovarian cancer patients (*n* = 33)
PG-SGA ≥ 2	Well	49 (33.4)	30 (34.1)	12 (46.2)	7 (21.2)
	Malnutrition	98 (66.7)	58 (65.9)	14 (53.8)	26 (78.8)
PG-SGA ≥ 4	Well	67 (45.6)	42 (47.7)	17 (65.4)	8 (24.2)
	Malnutrition	80 (54.4)	46 (52.3)	9 (34.6)	25 (75.8)
NRS-2002 ≥ 3	Well	65 (44.2)	40 (45.5)	15 (57.7)	10 (30.3)
	Malnutrition	82 (55.8)	48 (54.5)	11 (42.3)	23 (69.7)

Table 3 Consistency of NRS-2002 and PG-SGA (score ≥ 2 or 4) in gynecologic malignant patients (*k* value)

Reference method / Pathological classification	NRS-2002 ≥ 3			
	Total patients (*n* = 147)	Cervical cancer patients (*n* = 88)	Endometrial carcinoma patients (*n* = 26)	Ovarian cancer patients (*n* = 33)
PG-SGA ≥ 2	0.689	0.626	0.772	0.765
PG-SGA ≥ 4	0.643	0.589	0.516	0.848

cancer (k = 0.765) (Table 3). When the PG-SGA score ≥4 was set as the standard for the diagnosis of malnutrition, the result was similar for all patients (k = 0.643) and patients with cervical cancer (k = 0.589), endometrial carcinoma (k = 0.516), or ovarian cancer (k = 0.848) (Table 3).

When a PG-SGA score ≥ 2 was set as the "gold standard" to calculate the sensitivity and specificity of the NRS-2002 score ≥ 3, the sensitivity was 80.6% and the specificity 93.9% for all the patients (Fig. 1). When a PG-SGA score ≥ 4 was set as the "gold standard" to calculate the sensitivity and specificity of a NRS-2002 score ≥3, the sensitivity was 85.0% and the specificity was 79.1% for all the patients (Fig. 1).

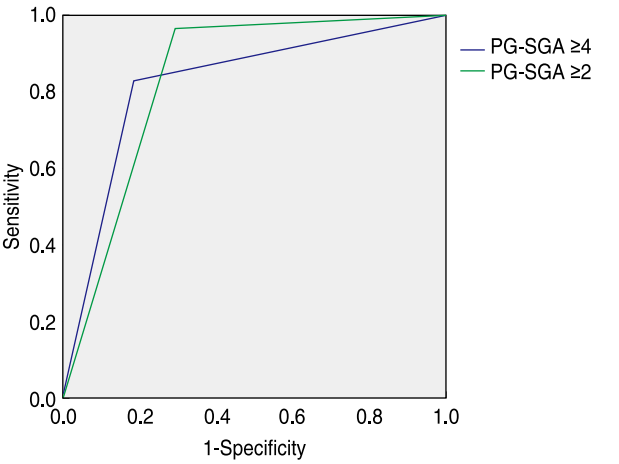

Fig. 1 Receiver-operating characteristic curve comparing NRS-2002 (score ≥ 3) to PG-SGA (score ≥ 2) or PG-SGA (score ≥ 4) in gynecologic malignant patients at admission

Association between nutritional scores and LOS

The nutritional scores of PG-SGA and NRS-2002 were positively correlated with LOS in the surgery group (Table 4) and chemotherapy group (Table 5). The specific manifestation presented a significantly higher proportion of prolonged LOS in malnourished patients than in those with normal nutritional status as assessed by either the PG-SGA or NRS-2002.

Discussion

Nutritional screening is the first step in developing an effective nutritional plan during admission. In our study, we explored the value of using the PG-SGA and NRS-2002 in assessing nutritional status and their predictive effects on LOS in a series of 147 gynecologic malignancy patients.

In this study, based on the PG-SGA, over 66.7% (PG-SGA score ≥ 2) and 54.4% (PG-SGA score ≥ 4) of patients had poor nutritional status. Using the NRS-2002 (score ≥ 3), we found 55.8% of patients at nutritional risk. The above results demonstrated that hospitalized patients with gynecologic malignancy had a substantial malnutrition or nutritional risk. These findings concurred with other studies, in which the prevalence of malnutrition was 62.4% as evaluated by the PG-SGA in those with gynecologic cancer [9, 18]. According to the PG-SGA, only 23.7% were classified as malnourished [21]. Moreover, using the NRS-2002, 35.8% were identified as

Table 4 Comparison of Prolonged LOS in Surgical Patients Evaluated by PG-SGA and NRS-2002 [*n* (%)]

Reference method		LOS		Spearman's Coefficients	*P* value
		Normal LOS	Prolonged LOS		
PG-SGA ≥ 2	Well (n = 29)	23 (79.3)	6 (20.7)	0.666	< 0.001
	Malnutrition (n = 36)	12 (33.3)	24 (66.7)		
PG-SGA ≥ 4	Well (n = 39)	31 (79.5)	8 (20.5)		< 0.001
	Malnutrition (n = 26)	4 (15.4)	22 (84.6)		
NRS-2002 ≥ 3	Well (n = 31)	27 (87.1)	4 (12.9)	0.071	< 0.001
	Malnutrition (n = 34)	8 (23.5)	26 (76.5)		

Table 5 Comparison of Prolonged LOS in Chemotherapy Patients Evaluated by PG-SGA and NRS-2002 [*n* (%)]

Reference Method		LOS		Spearman's Coefficients	*P* value
		Normal LOS	Prolonged LOS		
PG-SGA ≥2	Well (n = 20)	16 (80.0%)	4 (20.0%)	0.734	< 0.001
	Malnutrition (n = 62)	23 (37.1%)	39 (62.9%)		
PG-SGA ≥4	Well (n = 28)	23 (82.1%)	5 (17.9%)		< 0.001
	Malnutrition (n = 54)	16 (29.6%)	38 (70.4%)		
NRS-2002 ≥3	Well (n = 34)	28 (82.4%)	6 (17.6%)	0.728	< 0.001
	Malnutrition (n = 48)	11 (22.9%)	37 (77.1%)		

having nutritional risk [4]. Malnutrition or nutritional risk is also related to perioperative fasting, surgical trauma stress responses, increased metabolism, and decreased intake caused by radiotherapy and chemotherapy [12, 22–23]. In our study, not only patients who were previously untreated, but also those who had received surgery and (or) chemotherapy were included. This may be the main reason for the higher malnutrition rate or nutritional risk in this study.

The prevalence of malnutrition may be affected by different evaluation tools and tumor sites. Orell-Kotikangas *et al.* found that 69.5% of patients with multiple types of malignant tumors had nutritional risks as evaluated by NRS-2002 [24]. Another study reported 20-88% of patients with gynecological cancer had some degree of malnutrition 23. We also observed malnutrition in patients with malignant gynecologic tumors in different sites. We found that patients with ovarian cancer had a relatively high incidence of malnutrition, while patients with endometrial carcinoma had a relatively low incidence of malnutrition. Rodrigues *et al.* 18 also found that patients with endometrial carcinoma showed a significantly lower median score compared to those with cervical and ovarian tumors. Additionally, Zorlini *et al.* reported a significantly higher prevalence of malnutrition in patients with endometrium cancer as opposed to those with cancer at other sites [25]. Laky and colleagues found that patients with ovarian cancer were more susceptible to nutritional status alterations, whereas those with endometrial and uterine cancers comprise a less predisposed group to such alterations [8]. This discrepancy may be related to (1) differences in sample size; (2) regional differences resulting in different dietary patterns that may influence the population nutritional status; (3) complications caused by cancer; and (4) different previous treatment regimens. Furthermore, the rate of malnutrition in patients with cancer seems to depend on multiple factors, including tumor sites, treatment, staging, and histology.

A general concordance and agreement (k value = 0.523) were observed between the PG-SGA and NRS-2002 in the diagnosis of malnutrition among patients with cervical cancer [13]. In our study, we also detected a high concordance and agreement (k statistic was 0.689 and 0.643 when the PG-SGA score was ≥ 2 and 4, respectively) between the two assessments when used for patients with gynecologic malignancy. Concordance between the PG-SGA and NRS-2002 was also supported by Helena in a study of patients with head and neck cancer [24]. The concordance between the PG-SGA and NRS-2002 was also observed in different gynecologic tumor sites. Despite the lack of homogeneity studies, both the PG-SGA and NRS-2002 are currently recommended for nutritional screening of patients with gynecologic malignancy. Although there are other nutrition assessment tools, there is a lack of consensus on which tool is the most suitable for patients with malignant tumors. Our findings demonstrated a high concordance between the two assessment tools and supported the use of the NRS-2002 and PG-SGA in patients with gynecologic cancer.

Good nutritional screening tools should show good specificity and sensitivity [14]. In our study, the NRS-2002 cut-off score of ≥ 3 compared with the PG-SGA showed high specificity and sensitivity in patients with gynecologic cancer. As mentioned before, this concurs with the findings from a large oncology study in patients with head and neck squamous cell carcinoma by Helena *et al* [24]. In particular, a PG-SGA nutritional status score of 7.5 predicted febrile neutropenia, with a sensitivity of 100% and a specificity of 60% in patients with gynecologic cancer, suggesting that these patients may have a higher baseline PG-SGA score [26]. A higher baseline provides a more accurate identification of malnourished patients. Our results showed that a NRS-2002 cut-off score of ≥ 3 and PG-SGA score≥ 2 or 4 are suitable for predicting the nutritional status of patients with gynecologic cancer.

Many nutritionally at-risk patients present with complications during admission. The effect of poor nutritional status on early readmissions and the development of complications have been previously demonstrated [27–28]. We also showed a positive correlation between LOS and compromised nutritional status as per the PG-SGA or NRS-2002. Further analysis revealed that a prolonged LOS is more common in patients with nutrition risk or those who are undernourished than patients with a good nutritional status. The PG-SGA has been validated as an assessment of nutritional status, which can be used to indicate a longer length of stay in patients with multiple types of cancer [15, 29]. A longer LOS was also observed in surgical patients with nutritional risks as identified by the NRS-2002 [30]. Overall, the LOS increased significantly in cancer patients with severe malnutrition and nutritional risk as identified by the PG-SGA or NRS-2002 [10, 31]. In patients with gynecologic malignancy, an association between malnutrition and LOS based on the PG-SGA score was found by Laky and colleagues [20]. In that study, the medial hospitalization time of patients with malnutrition as assessed by the NRS-2002 (score ≥ 3) was increased from 7 to 10 days [4]. The PG-SGA and NRS-2002 shared similar validity and good consistency in predicting the LOS of patients with gynecologic malignancy. This suggests that they could be used for nutritional screening at the time of admission of patients with gynecologic malignancy. The PG-SGA and NRS-2002 can be completed in a few minutes, unlike the Mini Nutritional Assessment, which is the most time-consuming tool (410 min) [32]. However, LOS is influenced by many factors other than nutritional

status, such as illness severity, disease, and age. Therefore, related research about LOS may have been biased because these studies did not address all the potential contributing factors [33].

It may be necessary for trained physicians to improve their competency in using the PG-SGA properly. NRS-2002 requires less training and is more convenient than the PG-SGA. In addition, several patient-related factors are influential to LOS, such as diagnosis, age, and hospital procedures such as elective surgeries. Therefore, further studies should 1) increase the number of research samples, 2) reduce population heterogeneity, and 3) apply the same treatment regimen as for other patients with cancer and specifically define the associations with age, complications, mortality, costs, and so on, in patients with gynecologic cancer.

In summary, our findings suggest that a high prevalence of moderate and severe malnutrition or nutritional risks are common among patients with gynecologic malignancy based on evaluations using the PG-SGA and NRS-2002. Furthermore, the PG-SGA and NRS-2002 correlated with each other. Either assessment can be used to predict prolonged LOS in patients with gynecologic malignancy.

Ethics approval

An ethics committee approval was obtained from Nanfang Hospital.

Conflicts of interest

The authors indicated no potential conflicts of interest.

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