Patient-Generated Subjective Global Assessment Short Form better predicts length of stay than Short Nutritional Assessment Questionnaire

Dewansingh, Priya; Euwes, Margreet; Krijnen, Wim P; Strijbos, Jaap H; van der Schans, Cees P; Jager-Wittenaar, Harriët

Published in:
Nutrition

DOI:
10.1016/j.nut.2021.111366

Publication date:
2021

Nutrition 91–92 (2021) 111366

Contents lists available at ScienceDirect

Nutrition

journal homepage: www.nutritionjrnl.com

Applied nutritional investigation

Patient-Generated Subjective Global Assessment Short Form better predicts length of stay than Short Nutritional Assessment Questionnaire

Priya Dewansingh MSc [a,*], Margreet Euwes MSc [b], Wim P. Krijnen PhD [a,c], Jaap H. Strijbos MD [d], Cees P. van der Schans PT, CE, PhD [a,e,f,g], Harriët Jager-Wittenaar PhD [a,h]

[a] Research Group Healthy Ageing, Allied Health Care and Nursing, Hanze University of Applied Sciences, Groningen, The Netherlands
[b] Acute Care Rehabilitation, Nij Smellinghe Hospital, Drachten, the Netherlands
[c] Faculty of Mathematics and Natural Sciences, University of Groningen, Groningen, the Netherlands
[d] Department of Lung Diseases, Nij Smellinghe Hospital, Drachten, the Netherlands
[e] Faculty of Medical Sciences, University Medical Center Groningen, Groningen, the Netherlands
[f] Department of Rehabilitation Medicine, University of Groningen, University Medical Center Groningen, Groningen, the Netherlands
[g] Department of Health Psychology Research, University of Groningen, University Medical Center Groningen, Groningen, the Netherlands
[h] Department of Oral and Maxillofacial Surgery, University of Groningen, University Medical Center Groningen, Groningen, the Netherlands

ARTICLE INFO

Article History:
Received 18 December 2020
Received in revised form 26 April 2021
Accepted 24 May 2021

Keywords:
Malnutrition
Predictive validity
Length of stay
PG-SGA
SNAQ

ABSTRACT

Objective: Malnutrition screening instruments used in hospitals mainly include criteria to identify characteristics of malnutrition. However, to tackle malnutrition in an early stage, identifying risk factors for malnutrition in addition to characteristics may be valuable.
The aim of this study was to determine the predictive validity of the Patient-Generated Subjective Global Assessment (PG-SGA SF), which addresses malnutrition characteristics and risk factors, and the Short Nutritional Assessment Questionnaire (SNAQ), which addresses mainly malnutrition characteristics, for length of stay (LOS) in a mixed hospital population.
Methods: Patients (N = 443) were screened with the PG-SGA SF and SNAQ in the first 72 h after admission to the lung, cardiology, or surgery ward. The McNemar–Bowker test was used to investigate the symmetry between the SNAQ and PG-SGA SF categorization for low, medium, and high risk. The predictive value of the PG-SGA SF and SNAQ was assessed by γ-regression before and after adjusting for several confounders.
Results: Of the 443 patients included, 23% and 58% were categorized as being at medium/high risk for malnutrition according to the SNAQ and PG-SGA SF, respectively. The regression analysis indicated that LOS of high-risk patients according to PG-SGA SF was 36% longer than that of low-risk patients ($P = 0.001$). LOS in patients at high risk according to the SNAQ did not significantly differ from that of SNAQ low-risk patients.
Conclusions: The PG-SGA SF, as a proactive malnutrition screening instrument, predicts LOS in various hospital wards, whereas the SNAQ, as a reactive instrument, does not. Therefore, we recommend the PG-SGA SF for proactive screening for malnutrition risk.

Introduction

Current estimates of the prevalence of malnutrition reveal that 20% to 50% of hospital patients are malnourished [1]. This variation is possibly caused by variation in screening and assessment methods, and hospital population [2,3]. Malnutrition is associated with poor clinical outcomes, including a longer hospital length of stay (LOS) [4–8].

Thus far, validated screening instruments have been implemented mostly for the purpose of identifying patients who are

PD was responsible for conceptualization, data curation, formal analysis, investigation, methodology, project administration, validation, visualization, and writing of the original draft. ME and HJW were responsible for conceptualization, methodology, resources, supervision, writing, review, and editing. JS was responsible for writing, review, and editing. WK was responsible for conceptualization, methodology, formal analysis, review, and editing. CP was responsible for conceptualization, methodology, supervision, visualization, writing, review, and editing.

*Corresponding author: Tel.: +31 640217313.
E-mail address: p.dewansingh@pl.hanze.nl (P. Dewansingh).

https://doi.org/10.1016/j.nut.2021.111366

malnourished at hospital admission [9], which can be considered a reactive malnutrition policy. Reactive malnutrition screening and assessment instruments focus mainly on critical weight loss [10]. Such instruments, like the Short Nutritional Assessment Questionnaire (SNAQ), which is used widely in the Netherlands, are effective in identifying hospital patients who have characteristics of present malnutrition [9,11].

Proactive screening of risk for malnutrition aims to identify patients having risk factors for future malnutrition, in addition to patients who are already malnourished [12]. Early identification of malnutrition and its accompanying risk factors is needed to facilitate nutritional treatment in a timely manner to prevent negative changes in nutritional status [13,14]. The most studied proactive screening instrument is the Patient-Generated Subjective Global Assessment Short Form (PG-SGA SF), which has mainly been used in patients with cancer [15]. The PG-SGA SF is a multidimensional instrument addressing short-, medium-, and long-term weight history, food intake, nutrition impact symptoms (NIS; i.e., symptoms hindering food intake), and activities and function [15]. NIS have proven to be significant predictors of reduced dietary intake and weight [16].

It is not known if screening proactively for both characteristics of malnutrition and its risk factors leads to higher predictive validity on LOS compared with reactive screening. Therefore, in the present study, we aimed to determine the predictive validity of a proactive malnutrition risk instrument with predictive validity of a reactive risk for malnutrition screening instrument in relation to LOS in a hospital setting.

Material and methods

Study design

In this cross-sectional study, patients admitted to the regional hospital Nij Smellinghe, located in Drachten, the Netherlands, were recruited from August 3, 2016 to June 12, 2017. The following inclusion criteria were applied: ≥18 y of age; admission to the lung disease, cardiology, or surgery wards; and measurements performed within 72 h of hospital admission. Patients were excluded when they could not write or speak Dutch, or if they had severe cognitive problems. This study was approved by the Medical Ethics Committee of hospital Nij Smellinghe. Informed consent was obtained from all participants before study measurements were performed.

Study measures

The PG-SGA [12,15] was translated and culturally adapted to the Dutch setting in 2014 [17]. The PG-SGA SF, which consists of scores assigned to questions divided over four boxes, addressing weight history (Box 1), food intake (Box 2), NIS (Box 3), and activities and function (Box 4), was completed by the patient. When the patient was unable to fill in the PG-SGA SF, the researcher, dietitians in training, and/or family members assisted. All weight values (i.e., the current, 1 mo ago, and 6 mo ago), as well as height were self-reported by the patient. Based on the numeric scores from the four boxes, patient risk for malnutrition was categorized as low (0–3 points), medium or high (≥4 points), or high (≥9 points) [12,18,19]. Body mass index (BMI) was calculated with the information from the PG-SGA SF about current weight and height (kg/m^2).

SNAQ contains the following three questions:

1. "Did you lose weight unintentionally? More than 6 kg in the past 6 mo (3 points) or more than 3 kg in the past month?" (2 points);
2. "Did you experience a decreased appetite over the past month?" (1 point);
3. "Did you use supplemental drinks or tube feeding over the past month?" (1 point).

Low-risk for malnutrition according to the SNAQ was defined as 0 to 1 point, medium and high as 2 to 7 points, and high as >2 points [9].

Information on LOS, age, sex, diagnosis, and comorbidity was retrieved from the medical records. Comorbidities, if present, were converted to the Charlson Comorbidity Iindex (CCI) by assigning a weighted score to each of 17 comorbidities [20]. For diagnosis, due to a variety of diagnoses, 11 main categories were formed using the International Classification of Disease (ICD-10) [21]. The categories were respiratory, cancer, fractures, trauma, circulatory, infectious and parasitic, eye and ear, musculoskeletal, digestive system, endocrine and metabolic diseases, urinary system and kidney disease, and other.

Statistical analyses

Statistical analyses were carried out using SPSS version 24 (SPSS Inc, Chicago, IL, USA). Descriptive statistics including frequencies and percentages were produced for sex, hospital wards, PG-SGA SF categories, SNAQ categories, medical diagnosis, and the CCI. Mean and ± SD are reported for the variables age and BMI. Median and interquartile range (IQR) are reported for LOS and PG-SGA SF scores. Normality was tested with the Shapiro–Wilk test. A 3 × 3 table was used to depict the SNAQ and PG-SGA SF categories (i.e., low, medium, and high risk for malnutrition). The McNemar–Bowker test was used to test symmetry in the cross tabulation of SNAQ by PG-SGA SF categories.

Prevalence of risk for malnutrition and PG-SGA SF box scores are reported as frequencies with percentages or median and IQR. The predictive value of both the PG-SGA SF and SNAQ was assessed by the generalized linear model (GLM), in which a log link for γ-regression as the outcome LOS, was measured as a non-negative (broken) counts of days according to Allen et al. [22]. The variables age, sex, BMI, diagnosis, and comorbidity were included in the GLM to correct for effects of these variables on LOS. Subgroup GLM analyses were performed per hospital ward (i.e., lung disease, cardiology, and surgery). Additionally, subgroup analysis with GLM analysis was performed on patients who scored low risk for malnutrition by the SNAQ, but medium or high risk according to the PG-SGA SF. In all analyses, statistical significance was set at $P < 0.05$.

Results

There were 443 patients included in the analyses. Table 1 shows the characteristics of the study sample and per hospital ward. Participants were 64.5 ± 14.6 y of age and had BMI of 26.7 ± 5.1 kg/m^2. More than half of the participants (54%) were men. In all, 128 (29%), 101 (23%), and 214 (48%) of the patients were admitted to the lung disease ward, cardiology ward, and surgery ward, respectively. All values were present for the scores of the PG-SGA boxes. According to the PG-SGA SF, 30% (n = 132) and 29% (n = 128) of participants were at medium and high risk for malnutrition, respectively. According to the SNAQ, 6% (n = 26) of participants were at medium risk for malnutrition, and 18% (n = 78) were at high risk for malnutrition (Fig. 1).

Prevalence of risk for malnutrition per screening instrument

Table 2 shows the 3 × 3 contingency table of the participants according to the SNAQ and PG-SGA SF risk for malnutrition categories. Half of the participants who were at low risk for malnutrition according to the SNAQ were at medium or high risk for malnutrition according to the PG-SGA SF. Of the participants at low risk for malnutrition according to the PG-SGA SF, 8% were at medium or high risk for malnutrition according to the SNAQ. Of the participants, 51% were categorized equally by the SNAQ and PG-SGA SF. The McNemar–Bowker test indicates rejection of the null hypothesis of symmetry of the SNAQ by PG-SGA SF cross tabulation ($P < 0.001$).

Table 3 summarizes the PG-SGA SF and SNAQ scores per risk for malnutrition category. The median PG-SGA SF score was 5 (IQR = 1–9), and 14% (n = 60) participants had a PG-SGA SF score of 0. Median SNAQ score was 0 (IQR = 0–1). Half (n = 223) of the participants had a SNAQ score of 0.

Subgroup analysis of risk for malnutrition per hospital ward

Figure 1 shows that across the three hospital wards, the PG-SGA SF categorized 2.5 times more participants at medium or high risk compared with the SNAQ. The PG-SGA SF categorized 3.1 times more participants at medium or high risk compared with the SNAQ for participants admitted to the lung diseases ward, and 2.7 times and 2.1 times more frequently for participants admitted to the cardiology and surgery wards, respectively.

Table 1
Characteristics of the study population

Demographic information	Total (N = 443)	Lung disease (n = 128)	Cardiology (n = 101)	Surgery (n = 214)
Age (y), mean ± SD	64.5 ± 14.6	64.6 ± 15.2	67.7 ± 11.2	62.9 ± 15.5
Men, n (%)	241 (54)	65 (51)	67 (66)	109 (51)
BMI (kg/m^2), mean ± SD	26.7 ± 5.1	26.4 ± 5.8	27.3 ± 11.2	26.6 ± 5.2
Diagnosis, n (%)				
Respiratory	123 (28)	112 (88)	10 (10)	1 (1)
Digestive system	90 (20)	2 (2)	2 (2)	86 (40)
Circulatory	77 (17)	2 (2)	65 (64)	10 (5)
Cancer	28 (6)	5 (4)	2 (2)	21 (10)
Fractures	28 (6)	0	1 (1)	27 (13)
Musculoskeletal	17 (4)	2 (2)	12 (12)	3 (1)
Urinary system and kidney disease	30 (7)	0	1 (1)	29 (14)
Other	50 (11)	5 (4)	8 (8)	37 (17)
Charlson Comorbidity Index score, n (%)				
0	254 (57)	72 (53)	40 (40)	142 (66)
1	106 (24)	30 (23)	31 (31)	45 (21)
2	52 (12)	15 (12)	18 (18)	19 (9)
3	20 (5)	6 (5)	7 (7)	7 (3
4	10 (2)	5 (4)	5 (5)	0
11	1 (0.2)	0	0	1 (1)
LOS, median (IQR)	4.2 (2.8–7.1)	4.8 (3.1–7.7)	3.9 (2.1–6.9)	4.2 (2.8–7.1)

BMI, body mass index; IQR, interquartile range; LOS, length of stay

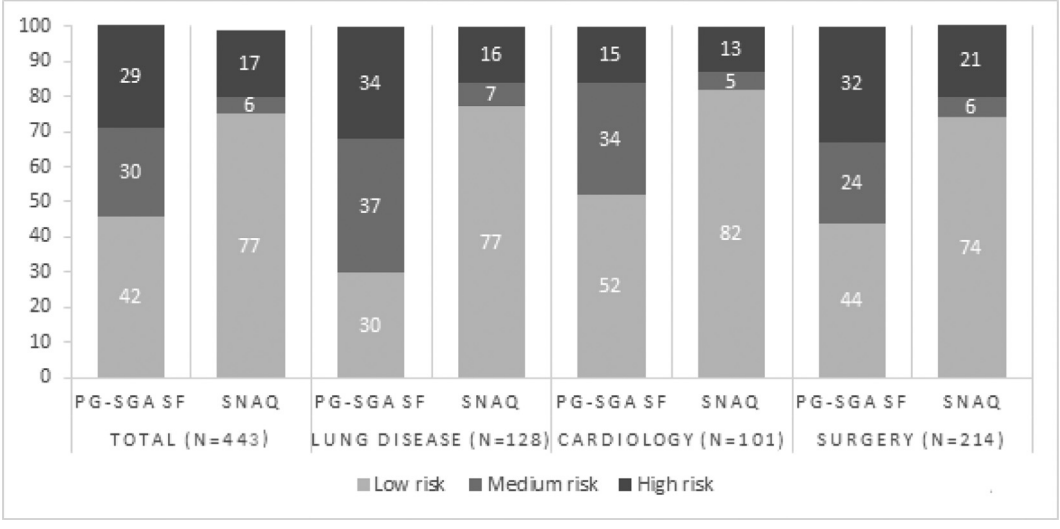

Fig. 1. Prevalence of risk for malnutrition per hospital ward, according to the SNAQ and PG-SGA SF. PG-SGA SF: low risk = 0–3 points, medium risk = 4–8 points, high risk ≥9 points. SNAQ: low risk = 0–1 points, medium risk = 2 points, high risk ≥3 points. PG-SGA SF, Patient-Generated Subjective Global Assessment Short Form; SNAQ, Short Nutritional Assessment Questionnaire.

Table 2
SNAQ and PG-SGA SF categorization (N = 443)

	Low risk	SNAQ Moderate risk	High risk	Total
PG-SGA SF				
Low risk	170	8	6	184
Medium risk	101	9	22	132
High risk	69	9	49	127
Total	340	26	77	443

PG-SGA SF, Patient-Generated Subjective Global Assessment Short Form; SNAQ, Short Nutritional Assessment Questionnaire
PG–SGA SF: low risk = 0–3 points, medium risk = 4–8 points, high risk ≥9 points
SNAQ: low risk = 0–1 points, medium risk = 2 points, high risk ≥3 points

Table 4 shows scores on the PG-SGA SF and SNAQ per hospital ward. Participants admitted to the lung disease wards had the highest total median score on the PG-SGA SF (i.e., 6 points [IQR = 2.25–9.75]). Lung disease patients mainly reported problems of food intake, NIS, and activities and function. The most frequently reported NIS in the lung disease participants were no appetite, dry mouth, and fatigue. Participants admitted to the cardiology ward had a total median PG-SGA SF score of 3 points (IQR = 1–7), and mainly reported NIS and problems with activities and function. The most reported NIS in these participants were no appetite, feeling full quickly, and fatigue. The total median PG-SGA SF score of participants admitted to the surgery ward was 4 (IQR = 1–10). The participants admitted to the surgery ward reported mainly problems with food intake and NIS, and their most reported NIS were no appetite, fatigue, nausea, and pain.

The median score (IQR) for the SNAQ per hospital ward was 1 (0–1) for the lung disease ward, and 0 (0–1) for the cardiology, and 0 (0–2) for the surgery ward.

Predictive value of risk for malnutrition on LOS

Participants at risk for malnutrition (i.e., medium and high risk) according to PG-SGA SF or SNAQ, had both a median hospital LOS of 4.9 d, respectively. High-risk participants according to PG-SGA

Table 3
PG-SGA SF and SNAQ scores per risk for malnutrition category (N = 443)

PG-SGA SF	Total sample (**N** = 443)	Low risk (n = 184)	Medium risk (n = 132)	High risk (n = 127)
Box 1: Weight score, **median (IQR)**	0 (0–1)	0 (0–0)	0 (0–1)	1 (0–1)
Box 2: Food intake score, **median (IQR)**	1 (0–1)	0 (0–0)	1 (0–1)	1 (1–3)
Box 3: NIS* score, **median (IQR)**	3 (0–6)	0 (0–1)	3 (2–4)	7 (6–9)
No problems eating, n (%)	218 (49)	151 (82)	56 (42)	12 (9)
No appetite, just did not feel like eating, n (%)	114 (26)	1 (0.5)	29 (22)	84 (66)
Nausea, n (%)	71 (16)	2 (1)	14 (11)	55 (43)
Constipation, n (%)	44 (10)	7 (4)	8 (6)	29 (23)
Mouth sores, n (%)	15 (3)	2 (1)	5 (4)	8 (6)
Things taste funny or have no taste, n (%)	54 (12)	4 (2)	13 (10)	37 (29)
Problems swallowing, n (%)	26 (6)	1 (0.5)	10 (8)	15 (12)
Pain, n (%)	93 (21)	3 (2)	32 (24)	59 (46)
Vomiting, n (%)	50 (11)	2 (1)	8 (6)	40 (32)
Diarrhea, n (%)	35 (8)	2 (1)	10 (8)	23 (18)
Dry mouth, n (%)	111 (25)	14 (8)	40 (30)	57 (45)
Smells bother me, n (%)	28 (6)	1 (0.5)	4 (3)	23 (18)
Feel full quickly, n (%)	82 (19)	4 (2)	26 (20)	52 (41)
Fatigue, n (%)	132 (30)	18 (10)	40 (30)	74 (58)
Other, n (%)	26 (6)	4 (2)	9 (7)	13 (10)
Box 4: Activities and function, **score, median (IQR)**	1 (0–2)	0 (0–1)	1 (0–2)	2 (1–3)
PG-SGA SF total score, **median (IQR)**	5 (1–9)	1 (0–2)	6 (5–7)	11 (10–15)
SNAQ, **n (%)**	Total sample (N = 443)	Low risk (n = 330)	Medium risk (n = 26)	High risk (n = 77)
6 kg weight loss in past 6 mo	58 (13)	0	0	57 (74)
3 kg weight loss in past month	53 (12)	1 (0.3)	15 (58)	37 (48)
Loss of appetite	175 (39)	106 (31)	12 (46)	57 (74)
Use of supplement drinks/tube feeding	42 (9)	12 (4)	11 (42)	19 (25)
SNAQ score, **median (IQR)**	0 (0–1)	0 (0–1)	2 (2–2)	4 (3–5)

IQR, interquartile range; NIS, Nutrition impact symptoms; n.a., not applicable; PG-SGA SF, Patient-Generated Subjective Global Assessment; SNAQ, Short Nutritional Assessment Questionnaire
PG-SGA SF: low risk = 0–3 points, medium risk = 4–8 points, high risk ≥9 points
SNAQ: low risk = 0–1 points, medium risk = 2 points, high risk ≥3 points
*Participants could indicate >1 NIS.

Table 4
Scores on the PG-SGA SF and SNAQ per hospital ward

PG-SGA SF	Total sample (**N** = 443)	Lung disease (n = 128)	Cardiology (n = 101)	Surgery (n = 214)
Box 1: Weight, **score, median (IQR)**	0 (0–1)	0 (0–0)	0 (0–1)	0 (0–1)
Box 2: Food intake, **score, median (IQR)**	1 (0–1)	1 (0–1)	0 (0–1)	1 (0–1)
Box 3: NIS,* **score, median (IQR)**	3 (0.25–6)	3 (0.25–6)	2 (0–4)	3 (0–6)
No problems eating, n (%)	218 (49)	40 (31)	62 (61)	116 (54)
No appetite, just did not feel like eating, n (%)	114 (26)	40 (31)	22 (22)	52 (24)
Nausea, n (%)	71 (16)	21 (16)	8 (8)	42 (20)
Constipation, n (%)	44 (10)	7 (6)	6 (6)	31 (15)
Mouth sores, n (%)	15 (3)	8 (6)	2 (2)	5 (2)
Things taste funny or have no taste, n (%)	54 (12)	28 (22)	9 (9)	17 (8)
Problems swallowing, n (%)	26 (6)	10 (8)	5 (5)	11 (5)
Pain, n (%)	93 (21)	23 (18)	13 (13)	57 (27)
Vomiting, n (%)	50 (11)	12 (9)	3 (3)	35 (16)
Diarrhea, n (%)	35 (8)	7 (6)	3 (3)	25 (12)
Dry mouth, n (%)	111 (2%)	40 (31)	21 (21)	50 (23)
Smells bother me, n (%)	28 (6)	12 (9)	4 (4)	12 (6)
Feel full quickly, n (%)	82 (19)	32 (25)	17 (17)	33 (15)
Fatigue, n (%)	132 (30)	48 (38)	30 (29)	54 (25)
Other, n (%)	26 (6)	7 (5)	10 (10)	11 (5)
Box 4: Activities and function, **score, median (IQR)**	1 (0–2)	1 (0–2)	1 (0–2)	0.5 (0–1)
PG-SGA SF score, median (IQR)	5 (1–9)	6 (2.25–9.75)	3 (1–7)	4 (1–10)
SNAQ, **n (%)**				
Weight loss in past 6 mo	58 (13)	12 (9)	11 (11)	34 (16)
Weight loss in past month	53 (12)	14 (11)	10 (10)	29 (14)
Loss of appetite	175 (39)	62 (48)	30 (30)	83 (39)
Use of supplement drinks/tube feeding	42 (9)	15 (12)	7 (7)	20 (9)
SNAQ score, median (IQR)	0 (0–1)	1 (0–1)	0 (0–1)	0 (0–2)

IQR, interquartile range; NIS, Nutrition impact symptoms; PG-SGA SF, Patient-Generated Subjective Global Assessment; SNAQ, Short Nutritional Assessment Questionnaire
*Participants could indicate >1 NIS (nutrition impact symptoms)

SF and SNAQ stayed 5.1 and 4.9 d in the hospital, respectively. Low-risk participants (reference category) according to PG-SGA SF and SNAQ had a median hospital LOS of 3.9 and 4.1 d, respectively.

Table 5 shows the predictive value of risk for malnutrition according to each instrument on LOS, by a univariate analysis, as well as a multivariate analysis after correcting for various

Table 5
Length of stay for PG-SGA SF and SNAQ risk for malnutrition categories (N = 443)

Instrument	Risk for malnutrition category	Multiplication factor; 95% CI	LOS (d)	*P*-value
Univariate model				
SNAQ	Low risk (n = 330)	Reference	4.10	
	Medium risk (n = 26)	1.08; 95% CI, 0.80–1.45	4.43	0.620
	High risk (n = 77)	1.15; 95% CI, 0.96–1.39	4.72	0.133
PG-SGA SF	Low risk (n = 184)	Reference	3.90	
	Medium risk (n = 132)	1.24; 95% CI, 1.05–1.46	4.83	**0.011**
	High risk (n = 127)	1.36; 95% CI, 1.15–1.60	5.30	<**0.001**
Adjusted model*				
SNAQ	Low risk (n = 330)		4.10	
	Medium risk (n = 26)	0.98; 95% CI, 0.73–1.32	4.02	0.891
	High risk (n = 77)	1.11; 95% CI, 0.92–1.34	4.55	0.276
PG-SGA SF	Low risk (n = 184)		3.90	
	Medium risk (n = 132)	1.16; 95% CI, 0.98–1.37	4.52	0.087
	High risk (n = 127)	1.36; 95% CI, 1.14–1.62	5.30	**0.001**

BMI, body mass index; LOS, length of stay; PG-SGA SF, Patient-Generated Subjective Global Assessment Short Form; SNAQ, Short Nutritional Assessment Questionnaire
PG-SGA SF: low risk = 0–3 points, medium risk = 4–8 points, high risk ≥9 points
SNAQ: low risk = 0–1 points, medium risk = 2 points, high risk ≥3 points
*Model adjusted for age, sex, BMI, diagnosis, and comorbidities.

covariates per hospital ward. In the adjusted model, LOS of participants at medium risk according to PG-SGA SF did not significantly differ from LOS in participants at low risk (0–3 points). However, in patients at high risk according to PG-SGA SF, LOS was 36% longer ($P < 0.001$) than in low-risk participants. Additionally, participants at medium or high risk for malnutrition according to PG-SGA SF stayed significantly longer in the hospital than low-risk participants, according to both the univariate (30%, $P < 0.001$) and adjusted models (25%, $P = 0.003$).

For the SNAQ, no significant difference in LOS between the risk categories were found in neither the univariate nor multivariate analysis.

Table 6 shows the multivariate subgroup analysis on predictive validity of PG-SGA SF for LOS in participants at low risk according to the SNAQ. Participants categorized by SNAQ as low risk but as being at high risk according to the PG-SGA SF, stayed 45% longer ($P = 0.001$) in the hospital than participants categorized as being at low risk by both SNAQ and PG-SGA SF.

Table 7 shows the multivariate analysis on the relationship between malnutrition risk according to the PG-SGA SF and SNAQ and LOS per hospital ward. Participants admitted to the lung disease ward who were at high risk for malnutrition according to the PG-SGA SF had a 42% ($P = 0.021$) longer LOS than those at low risk according to the PG-SGA SF. For the cardiology ward, no significant differences in LOS between the medium- and high-risk participants compared with the low-risk group, respectively, were found. Participants admitted to the surgery ward who were at high risk according to the PG-SGA SF had a 51% ($P = 0.010$) longer LOS than participants at low risk according to the PG-SGA SF. In comparison, no significant difference in LOS between the SNAQ risk for malnutrition categories were found in any of the hospital wards.

Discussion

The present study demonstrates that the PG-SGA SF as proactive malnutrition screening instrument predicts hospital LOS, whereas the SNAQ as reactive instrument does not. According to the PG-SGA SF, patients at high risk for malnutrition stay 1.4 d longer than low-risk patients. Moreover, patients categorized as low risk according to the SNAQ but high risk according to the PG-SGA SF stayed 4.4 d longer in the hospital compared with patients categorized as low risk by both instruments. However, although the patients at high risk for malnutrition according to the PG-SGA SF admitted to the lung disease and surgery wards stayed significantly longer in the hospital, neither the PG-SGA SF nor SNAQ significantly predicted LOS in patients admitted to the cardiology ward.

To the best of our knowledge, this was the first study to compare the PG-SGA SF as a proactive instrument with the SNAQ as a reactive instrument in relation to hospital LOS. The findings of the present study support our hypothesis that a proactive malnutrition screening instrument has better predictive validity than a reactive screening instrument. This finding could be explained by the multidimensional character of the PG-SGA SF. The PG-SGA SF includes items covering the malnutrition domains of nutrient balance, body weight, and function [10], and also includes more different types of risk factors for malnutrition than the SNAQ. For example, in the present study, 44% of patients reported multiple NIS, such as no appetite, dry mouth, nausea, and fatigue. These NIS and decreased intake, as well as decreased activity and being bedridden, are likely to delay the patient's time of recovery in the hospital, and are all included in the PG-SA SF. Other studies also found positive associations between presence of NIS and reduced intake, involuntary

Table 6
Multivariate subgroup analysis on predictive validity of PG-SGA SF for LOS in participants at low risk for malnutrition according to the SNAQ (N = 340)

Instrument	Malnutrition risk category	Multiplication factor; 95% CI	LOS (d)	*P*-value
Univariate model				
PG-SGA SF	Low risk (n = 170)	Reference	3.86	
	Medium risk (n = 101)	1.24; 95% CI, 1.05–1.46	4.78	**0.045**
	High risk (n = 69)	1.36; 95% CI, 1.15–1.60	5.25	**0.001**
Adjusted model*				
PG-SGA SF	Low risk (n = 170)	Reference	3.86	
	Medium risk (n = 101)	1.13; 95% CI, 0.94–1.36	4.36	0.198
	High risk (n = 69)	1.45; 95% CI, 1.16–1.82	5.60	**0.001**

BMI, body mass index; LOS, length of stay; PG-SGA SF, Patient-Generated Subjective Global Assessment Short Form; SNAQ, Short Nutritional Assessment Questionnaire
PG-SGA SF: low risk = 0–3 points, medium risk = 4–8 points, high risk ≥9 points
*Model adjusted for age, sex, BMI, diagnosis, and comorbidities.

Table 7
LOS according to PG-SGA SF and SNAQ risk for malnutrition categories per hospital ward

Hospital ward	Instrument	Malnutrition risk category	Multiplication factor; 95% CI	LOS (d)	*P*-value
Lung disease	Univariate model				
	SNAQ	Low risk (n = 99)	Reference	5.77	
		Medium risk (n = 9)	1.01; 95% CI, 0.64–1.59	5.83	0.965
		High risk (n = 20)	1.01; 95% CI, 0.74–1.39	5.83	0.953
	PG-SGA SF	Low risk (n = 38)	Reference	4.18	
		Medium risk (n = 47)	1.10; 95% CI, 0.83–1.45	4.60	0.511
		High risk (n = 43)	1.39; 95% CI, 1.04–1.84	5.81	**0.021**
	Adjusted model*				
	SNAQ	Low risk (n = 99)	Reference	5.77	
		Medium risk (n = 9)	0.97; 95% CI, 0.62–1.52	5.60	.0.903
		High risk (n = 20)	1.08; 95% CI, 0.79–1.48	6.23	0.636
	PG-SGA SF	Low risk (n = 38)	Reference	4.18	
		Medium risk (n = 47)	1.12; 95% CI, 0.86–1.47	4.68	0.406
		High risk (n = 43)	1.42; 95% CI, 1.05–1.89	5.94	**0.021**
Cardiology	Univariate model				
	SNAQ	Low risk (n = 83)	Reference	3.89	
		Medium risk (n = 5)	1.27; 95% CI, 0.60–2.70	4.94	0.539
		High risk (n = 13)	1.23; 95% CI, 0.75–2.00	4.78	0.417
	PG-SGA SF	Low risk (n = 52)	Reference	3.47	
		Medium risk (n = 34)	1.10; 95% CI, 0.95–1.95	3.82	0.090
		High risk (n = 15)	1.39; 95% CI, 0.52–1.33	4.82	0.443
	Adjusted model*				
	SNAQ	Low risk (n = 83)	Reference	3.89	
		Medium risk (n = 5)	0.82; 95% CI, 0.38–1.78	3.19	0.614
		High risk (n = 13)	1.19; 95% CI, 0.72–1.95	4.63	0.501
	PG-SGA SF	Low risk (n = 52)		3.47	
		Medium risk (n = 34)	1.19; 95% CI, 0.83–1.72	4.13	0.342
		High risk (n = 15)	0.69; 95% CI, 0.41–1.15	2.39	0.156
Surgery	Univariate model				
	SNAQ	Low risk (n = 158)	Reference	4.08	
		Medium risk (n = 12)	1.04; 95% CI, 0.68–1.61	4.24	0.846
		High risk (n = 44)	1.18; 95% CI, 0.92–1.51	4.81	0.186
	PG-SGA SF	Low risk (n = 94)	Reference	3.83	
		Medium risk (n = 51)	1.28; 95% CI, 1.00–1.64	4.90	**0.050**
		High risk (n = 69)	1.43; 95% CI, 1.14–1.80	5.48	**0.002**
	Adjusted model*				
	SNAQ	Low risk (n = 158)	Reference	4.08	
		Medium risk (n = 12)	0.81; 95% CI, 0.53–1.25	3.30	0.345
		High risk (n = 44)	1.13; 95% CI, 0.89–1.43	4.61	0.327
	PG-SGA SF	Low risk (n = 94)	Reference	3.83	
		Medium risk (n = 51)	1.16; 95% CI, 0.92–1.48	4.44	0.213
		High risk (n = 69)	1.51; 95% CI, 1.20–1.90	5.78	<**0.001**

BMI, body mass index; LOS, length of stay; PG-SGA SF, Patient-Generated Subjective Global Assessment Short Form; SNAQ, Short Nutritional Assessment Questionnaire
PG-SGA SF: low risk = 0–3 points, medium risk = 4–8 points, high risk ≥9 points
SNAQ: low risk = 0–1 points, medium risk = 2 points, high risk ≥3 points
*Model adjusted for age, sex, BMI, diagnosis, and comorbidities.

weight loss, and survival, respectively, in patients with head and neck cancer [16,23]. Therefore, it seems useful to proactively identify presence of NIS, to enable timely interdisciplinary interventions to treat NIS. Future research is necessary to determine the effectiveness of interventions targeting NIS on reducing LOS.

The results of the present study on the predictive validity of the PG-SGA SF in relation to LOS are in line with results of previous studies [24,25]. Previous research on the predictive value of the PG-SGA has been performed with the full PG-SGA rather than the PG-SGA SF. However, differences in the association with LOS between the two versions of the PG-SGA are not expected as both are strongly correlated ($r = 0.984$; $P < 0.001$) [14]. An explanation for this strong correlation is that the large majority of the point score of the full PG-SGA is generated by the PG-SGA SF [12].

This study showed that the different hospital wards scored differently on the PG-SGA SF. The lung disease and surgery ward participants scored mainly on the NIS. Patients with lung disease more often reported a dry mouth, altered taste perception, and feelings of satiety compared with patients from the surgery ward. More surgical patients reported nausea, vomiting, constipation, paint, and diarrhea compared with patients having lung disease. Patients on the cardiology ward appeared less inflicted by malnutrition risk as they reported fewer problems with food intake and reported less NIS. Additionally, weight loss is difficult to identify in these cardiology as edema, which is often present in in this group, can mask weight loss. Therefore, risk for malnutrition can be harder to detect in cardiology patients when a malnutrition instrument that focuses mainly on weight loss, like the SNAQ, is used.

Interestingly, the present results on the lack of predictive value of the SNAQ in relation to LOS are different from previous findings. In particular, a study with 564 063 participants found that patients at high risk for malnutrition according to the SNAQ stayed 1.4 d longer in the hospital [11]. However, on the basis of PG-SGA SF risk groups, in the present study we found a significant increase in LOS with a sample size 1000 times smaller, indicating that the PG-SGA SF can already significantly predict LOS in a smaller hospital sample size, whereas the SNAQ did not find a significant difference between malnutrition risk categories in the same sample size and hospital population. In daily hospital practice, it is important to choose a malnutrition screening instrument that is capable of detecting patients who are at risk for malnutrition and also which patients are more likely to have a longer LOS. Therefore, the PG-

SGA SF is suitable choice. Additionally, in the present study the relationship between malnutrition risk and LOS was corrected for several covariables (e.g., age, sex, BMI, diagnosis, and comorbidities). In several studies, having multiple comorbidities and a diagnosis of cancer have been shown to be contributors to a longer LOS [26,27]. Correcting for these potential confounders better represents the actual process in patients, where the explanatory variable simultaneously influences LOS rather than separately. Additionally, the present findings suggest that the association between risk for malnutrition and LOS represents a unique source of explanatory variance not covered by the confounding explanatory variables.

The results of this study can be generalized to the hospital population. The construct of malnutrition has been defined as "a state resulting from lack of uptake or intake of nutrition leading to altered body composition (decreased fat free mass) and body cell mass leading to diminished physical and mental function and impaired clinical outcome from disease" [28], and this definition is not disease-specific. The PG-SGA SF covers all domains of the malnutrition definition [10]. Moreover, the present study has the same comparable mean age, sex ratio, and median LOS as another study that investigated risk for malnutrition prevalence in the Netherlands by including 12 other Dutch hospitals and their 27 different hospital wards [11], indicating that our patient sample was representative for the hospital population in general.

The present study had various implications for clinical practice and future research. First, proactive screening that includes not only identification of malnourished patients but also of patients being at risk for future malnutrition gives the opportunity for early nutritional support, which might prevent deterioration in nutritional status. Patients at risk for malnutrition according to the PG-SGA SF mainly score on presence of NIS, which can decrease nutritional intake and cause weight loss [16]. The PG-SGA SF gives information on the cause of an increased risk for malnutrition, which can be used to start an intervention by a dietitian and/or other relevant health care professionals, dependent on the underlying risk factor(s). If the goal of the hospital is to identify treatable risk factors for malnutrition early on, the PG-SGA SF is more qualified when compared with the SNAQ, due to better predicative validity on LOS, but also by including more malnutrition risk factors, and therefore better recognition of patients at risk for future malnutrition. Further research is needed to show the effectiveness of proactive screening as well as treatment of risk for malnutrition.

Second, using the PG-SGA SF facilitates triaging for interdisciplinary nutritional interventions, which may improve overall effectiveness of interventions. For example, the dietitian's treatment might be more effective when underlying symptoms hindering food intake like fatigue, pain, dry mouth, nausea, vomiting, constipation, mouth sores, and/or diarrhea are treated or prevented. Additionally, because >25% of the patients reported being limited in activity and function (PG-SA SF Box 4), treatment by a physical therapist might benefit these patients [29]. However, future research is needed to demonstrate improved effectiveness of interdisciplinary interventions compared with mono-disciplinary based on screening and triaging according to PG-SGA SF scores.

Conclusion

This study demonstrated that the PG-SGA SF as a proactive malnutrition screening instrument, predicts LOS in various hospital wards, whereas the SNAQ as a reactive instrument does not. The multidimensional PG-SGA SF identifies more than twice the number of patients at risk for malnutrition than the SNAQ; thus for the hospital setting, we recommend using the PG-SGA SF to screen for risk for malnutrition.

Acknowledgments

The authors acknowledge the students Nutrition and Dietetics Marit Dankert, Eva Melsen, and Frederiek Bosch of the Hanze University of Applied Sciences for their assistance in the data collection for this study.

References

[1] Norman K, Pichard C, Lochs H, Pirlich M. Prognostic impact of disease-related malnutrition. Clin Nutr 2008;27:5–15.
[2] Pathirana AK, Lokunarangoda N, Ranathunga I, Santharaj WS, Ekanayake R, Jayawardena R. Prevalence of hospital malnutrition among cardiac patients: results from six nutrition screening tools. Springerplus 2014;3:1–7.
[3] Van Bokhorst-de van der Schueren MAE, Guaitoli PR, Jansma EP, de Vet HCW. Nutrition screening tools: does one size fit all? A systematic review of screening tools for the hospital setting. Clin Nutr 2014;33:39–58.
[4] Cederholm T, Jensen GL, Cederholm T, Correira MITD, Gonzalez MC, Fukushima R, et al. GLIM criteria for the diagnosis of malnutrition – a consensus report from the global clinical nutrition community. J Parenter Enter Nutr 2019:43.
[5] Lew CCH, Yandell R, Fraser RJL, Chua AP, Chong MFF, Miller M. Association between malnutrition and clinical outcomes in the intensive care unit: a systematic review. Am Soc Parenter Enter Nutr 2017;41:744–58.
[6] Sullivan ES, Ní Bhuachalla E, Cushen S, Power DG. Malnutrition and body composition predict poor quality of life and reduced survival in ambulatory oncology patients receiving chemotherapy: a cross sectional study of 1015 patients. Proc Nutr Soc 2018;77.
[7] Hugo C, Cockburn N, Ford P, March S, Isenring E. Poor nutritional status is associated with worse oral health and poorer quality of life in aged care residents. J Nurs Home Res 2016;2:118–22.
[8] Gupta D, Vashi PG, Lammersfeld CA, Braun DP. Role of nutritional status in predicting the length of stay in cancer: a systematic review of the epidemiological literature. Ann Nutr Metab 2011;59:96–106.
[9] Kruizenga HM, Seidell JC, de Vet HCW, Wierdsma NJ, van Bokhorst-de van der Schueren MAE. Development and validation of a hospital screening tool for malnutrition: the Short Nutritional Assessment Questionnaire (SNAQ). Clin Nutr 2005;24:75–82.
[10] Sealy MJ, Nijholt W, Stuiver MM, van der Berg MM, Roodenburg JLN, van der Schans CP, et al. Content validity across methods of malnutrition assessment in patients with cancer is limited. J Clin Epidemiol 2016;76:125–36.
[11] Kruizenga H, Van Keeken S, Weijs P, Bastiaanse L, Beijer S, Huisman-De Waal G, et al. Undernutrition screening survey in 564,063 patients: patients with a positive undernutrition screening score stay in hospital 1.4 d longer. Am J Clin Nutr 2016;103:1026–32.
[12] Jager-Wittenaar H, Ottery FD. Assessing nutritional status in cancer: role of the Patient-Generated Subjective Global Assessment. Curr Opin Clin Nutr Metab Care 2017;20:322–9.
[13] August DA, Huhmann MB. A.S.P.E.N. clinical guidelines: nutrition support therapy during adult anticancer treatment and in hematopoietic cell transplantation. JPEN J Parenter Enteral Nutr 2009;33:472–500.
[14] Gabrielson DK, Scaffidi D, Leung E, Stoyanoff L, Robinson J, Nisenbaum R, et al. Use of an abridged scored Patient-Generated Subjective Global Assessment (abPG-SGA) as a nutritional screening tool for cancer patients in an outpatient setting. Nutr Cancer 2013;65:234–9.
[15] Ottery FD. Definition of standardized nutritional assessment and interventional pathways in oncology. Nutrition 1996;12:S15–9.
[16] Kubrak C, Olson K, Jha N, Jensen L, McCargar L, Seikaly H, et al. Nutrition impact symptoms: key determinants of reduced dietary intake, weight loss, and reduced functional capacity of patients with head and neck cancer before treatment. Head Neck 2009;32:290–300.
[17] Sealy MJ, Haß U, Ottery FD, van der Schans CP, Roodenburg JLN, Jager-Wittenaar H. Translation and cultural adaptation of the scored Patient-Generated Subjective Global Assessment. Cancer Nurs 2018;41:450–62.
[18] ter Beek L, Banning LBD, Visser L, Roodenburg JLN, Krijnen WP, van der Schans CP, et al. Risk for malnutrition in patients prior to vascular surgery. Am J Surg 2018;216:534–9.
[19] Banning LBD, ter Beek L, El Moumni M, Visser L, Zeebregts CJ, Jager-Wittenaar H, et al. Vascular surgery patients at risk for malnutrition are at an increased risk of developing postoperative complications. Ann Vasc Surg 2020;64:213–20.
[20] Sundararajan V, Henderson T, Perry C, Muggivan A, Quan H, Ghali WA. New ICD-10 version of the Charlson comorbidity index predicted in-hospital mortality. J Clin Epidemiol 2004;57:1288–94.
[21] World Health Organization. International statistical classification of diseases and related health problems: 10th revision. Geneva, Switzerland: Author; 2011.
[22] Allen LA, Smoyer Tomic KE, Wilson KL, Smith DM, Agodoa I. The inpatient experience and predictors of length of stay for patients hospitalized with systolic heart failure: comparison by commercial, Medicaid, and Medicare payer type. J Med Econ 2013;16:43–54.
[23] Farhangfar A, Makarewicz M, Ghosh S, Jha N, Scrimger R, Gramlich L, et al. Nutrition impact symptoms in a population cohort of head and neck cancer patients: multivariate regression analysis of symptoms on oral intake, weight loss and survival. Oral Oncol 2014;50:877–93.

[24] Härter J, Orlandi SP, Gonzalez MC. Nutritional and functional factors as prognostic of surgical cancer patients. Support Care Cancer 2017;25:2525–30.
[25] Bauer J, Capra S, Ferguson M. Use of the scored Patient-Generated Subjective Global Assessment (PG-SGA) as a nutrition assessment tool in patients with cancer. Eur J Clin Nutr 2002;56:779–85.
[26] Cereda E, Klersy C, Pedrolli C, Cameletti B, Bonardi C, Quarleri L, et al. The Geriatric Nutritional Risk Index predicts hospital length of stay and in-hospital weight loss in elderly patients. Clin Nutr 2015;34:74–8.
[27] Felder S, Lechtenboehmer C, Bally M, Fehr R, Deiss M, Faessler L, et al. Association of nutritional risk and adverse medical outcomes across different medical inpatient populations. Nutrition 2015;31:1385–93.
[28] Sobotka L, Allison SP, Forbes A. Basics in clinical nutrition. 4th ed. Czech Republic: Galen; 2011.
[29] Tanner RE, Brunker LB, Agergaard J, Barrows KM, Briggs RA, Kwon OS, et al. Age-related differences in lean mass, protein synthesis and skeletal muscle markers of proteolysis after bed rest and exercise rehabilitation. J Physiol 2015;15:4259–73.